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THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN AND THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION.

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Retrospective, 1923.

This year, though it has been relatively free from serious labour upheavals, has failed to fulfil general expectations so far as the foundry industry is concerned. At the risk of being charged with over-repetition, we find it necessary to point out that the foundry industry does not admit of a separate identity so far as trade classification is concerned, nor does it follow any other particular industry. One foundry we know confines its activities entirely to the manufacture of piano frames, another to a typescript duplication machine, and a third to boot protectors. These foundries scarcely respond to activity and depression in shipbuilding, engineering, textile, and building trades. Herein lies the impossibility of stating whether the passing year has been good or bad for the foundries as a whole. In a very general way trade, judged from the present low standard, was satisfactory to the end of April; it was followed by an acute depression, which reached its maximum in August, since when it has gradually been picking up. Trade-union employment figures confirm this. The adjustment of freights has helped the foundrymen slightly during the year, but more concessions are still imperative, as the foundry freight bill is relatively high compared with the drop forgers and other allied yet competing industries.

The passing year will always stand out as the beginning of a new technical era for the foundry world, as, for the first time in history, there has been a true international gathering of foundry experts. Obviously the outstanding features of such a gathering were the questions of the provision of an international standard test bar and the buying of pig-iron to analysis. It is recognised that there are two aspects for the former, one being the provision of a bar universally commercially acceptable, and the second, a bar the results obtained from which would be comparable no matter where obtained. Finality was not obtained with either question, and for the provision of test-bar there was not even found a common basis as a jumping-off point. The position is due to the fact that with the worst proposition from the metallurgical point of view, there is domestic acceptation and much practical experience to lend support to it. With the other two propositions, there are shown many metallurgical advantages, but intensive domestic acceptation does not exist. The British proposals fall into the second category, and whilst we do not hesitate to recommend that every step should be taken to make them a national standard, it is obvious that British foundry opinion, when thus reinforced, will be less likely to accept the views propounded by other nations. The only solution would appear to be in the direction of making metallurgical desiderata of the smallest importance compatible with "conscience," and concentrate on the commercial aspect of the case. To obtain this, the committee appointed in Paris should be widened to take in engineers and buyers.

The Manchester meeting of the Institute was an outstanding success, and the decision to ask Mr. Oliver Stubbs to preside over the destinies of the Institute for a second period has been more than justified by the results achieved. Amongst these results are the constantly increasing interest in foundry matters by leaders in allied industries: the brilliant organisation formed to entertain the delegation of the American Foundrymen's Association and the constantly increasing output of foundry technical literature, which is of a higher order every year. Metallurgy being the only bond between foundries, many foremen have mastered some of its principles and are passing technical information to the moulder, pattern-maker, and furnaceman.

The British Cast-Iron Research Association continues to make progress. Its position will be better known when the annual meeting, which the Parliamentary elections have delayed, takes place. Mr. J. T. Pearce, who has been appointed Director of the Association, comes with a reputation of an organiser and a pure research worker. We congratulate him on his appointment. We understand he will have the benefit of Mr. J. E. Fletcher's co-operation for foundry technical problems. The combination should prove of the greatest value to the ironfoundry industry.

Correspondence.

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

Pot Money.

To the Editor of THE FOUNDRY TRADES JOURNAL.

SIR,—My attention has been drawn to a recent article published in your journal regarding "pot money" and the detrimental influence it has on the technical development in the foundry.

You suggested two remedies which might be applied, but I think there is a third one which has not occurred to a large number of the users of crucibles in this country. I refer to the bonus system, which has been adopted by some of our leading firms and which has proved extremely beneficial to both employer and employee.

In the first place the workman is given an interest in his job and has a definite incentive in getting the best results possible. In the second place, the employer has the double advantage of lowest cost per ton of metal melted plus full value from the most economical pots after costing tests.

I have been told of instances where melting costs have been reduced in astounding proportions on changing over from the old method of handing out pots indiscriminately to that of paying the caster an extra on every heat obtained over and above a certain determined number.

I hope you will think this suggestion warrants publication.—Yours, etc.,

FERNAND ESPIR.

68, Coleman Street, London, E.C.2.
December 21, 1923.

"Motorailer" Wheels.

To the Editor of THE FOUNDRY TRADES JOURNAL.

SIR,—We read with interest the description of the "Motorailer" wheel in this week's issue of your valuable paper.

We have had some considerable experience in petrol locomotive units, and we wish to make a few remarks to prevent any misapprehension which your readers may have from the description given.

In the first place—an ordinary car is unsuitable for use as a haulage unit on rails, due to the fact that the power-weight ratio is too high.

Designers of cars are faced with the problem of —how to get the weight of the vehicles as low as possible, and the power as high as possible. On the other hand, locomotive designers find it necessary not only to get the power high, but also the weight high, and in fact with them it is the question of total weight all the time. Further, the differential of a motor car makes it most unsuitable for use on rails.—Yours, etc.,

DOMINION MALLEABLE, LIMITED.
H. A. STEVENSON,
Director.

P.S.—The tractive effort on rails of a 20-h.p. car would not be sufficient to move one truck, whereas the same power applied efficiently would move 100 tons at least.

Rolfe Street, Smethwick.
Birmingham.
December 21, 1923.

Trade Talk.

GEORGE CRADOCK & COMPANY, LIMITED, Wakefield, have removed their London office to 47, Lime Street, E.C.3.

CLAYTON WAGONS, LIMITED, are to supply the London Midland & Scottish Railway Company with 250 mineral wagons.

VIVIAN & SONS, LIMITED, of Swansea, have removed their London office to Bartlett House, 9, Basinghall Street, London, E.C.2.

EDWARD PENNINGTON, LIMITED, have removed from 124, Fenchurch Street, London, E.C.3, to 16 and 17, Devonshire Square, E.C.2.

BRUCE PEEBLES & COMPANY, LIMITED, Edinburgh, are closing their works from Saturday, December 29, until Monday, January 7, inclusive.

THE SEVENTH ANNUAL EXHIBITION organised by "The Model Engineer" will be held at the Royal Horticultural Hall, Westminster, S.W., from January 4 to 11.

A LECTURE ON THE heat-treatment of files was given to members of the Sheffield File Trade Technical Society by Dr. T. Swinden on December 13. Mr. J. H. Marsdin presided.

A NEW DRY GAS CLEANING PLANT has been installed at the works of the Blaenavon Company, Limited, by Fraser & Chalmers, Limited, of Erith, and was put into commission recently.

IT HAS BEEN officially learned that D. & W. Henderson & Company, Limited, Meadowside, Partick, have secured a contract for two cross-Channel cargo steamers for the Southern Railway Company.

WM. BEARDMORE & COMPANY, LIMITED, are removing their publicity and printing department from 183, West George Street, Glasgow, to 3, Manchester Street, Manchester Square, London, W., on January 1 next.

A LECTURE of interest to the mining community was given in the Carnegie Library, Newcastle, on December 13, when Professor G. Poole, of Armstrong College, gave the results of some of his personal researches at recent mine disasters.

THE METROPOLITAN CARRIAGE, WAGON & FINANCE COMPANY, LIMITED, have secured the order from the Madras and South Mahratta Railway for 150 covered goods wagons and 135 similar wagons for the Bombay, Baroda and Central India Railway.

A MEETING OF shareholders of Platt Bros., Limited, confirmed a resolution authorising alterations in the articles of association to enable the maximum number of directors to be increased from seven to ten and the employees' directors from four to five.

THE OUTPUT from the Wear shipbuilding yards for the present year is the lowest since 1876. Only 17 ships were launched, aggregating 56,522 gross tons. Five of the 15 yards on the river had no launches and five others launched only one vessel each.

CHAS. ROBERTS & COMPANY, LIMITED, have an order from the Cheshire Lines Committee for 500 12-ton freight wagons. A contract has also been placed with the same firm by the London Midland and Scottish Railway Company for 250 similar wagons.

CHARLES ROSS, LIMITED, Heeley Bridge Engineering Works, Sheffield, have just received an order from the Liverpool Gas Company for six 25-ton motor-wagon weighbridges, with platforms 20 ft. long by 8 ft. wide, to be fixed at six of their Liverpool works.

THE STUDENTS of the Walsall Engineering Society last week, in company with the president (Mr. H. D. Jackson) and Mr. J. A. Doran, head of the engineering section of the Walsall Municipal Institute, visited the foundries of F. H. Lloyd & Company, James Bridge.

THE OUTPUT of the Central Marine Engine Works, West Hartlepool, during the present year aggregated 20,335 i.h.p., made up as follow: "City of Eastbourne," 4,145 i.h.p.; "Bardistan," 3,580 i.h.p.; "Kohistan," 3,580 i.h.p.; "City of Athens," 4,515 i.h.p.; "Knaresbro," 4,515 i.h.p.

IN NOVEMBER there was only one launch on the Tyne, a steamer of 2,310 gross tons. In the eleven months of this year 39 vessels of 107,807 total gross tons were launched, as compared with 37 vessels and 205,690 tons in the corresponding period of last year, an increase of two vessels and a decrease of 97,883 tons.

THE LONDON MIDLAND & SCOTTISH RAILWAY COMPANY have placed orders in the Sheffield district for the supply of 30,000 tons of steel rails. The larger order, for 20,000 tons, has been given to Steel, Peech & Tozer, Limited, Sheffield, and 10,000 tons are to be supplied by Samuel Fox & Company, Limited, Stocksbridge.

PROFESSOR H. E. ARMSTRONG lectured on low-temperature carbonisation at a meeting of the Yorkshire Association of the Institution of Civil Engineers at Sheffield last week. Mr. H. E. Yerbury, of the Electrical Supply Department, Sheffield, who is the president of the Association, occupied the chair.

PROPOSING THE TOAST of the Institution of Electrical Engineers at the annual dinner of the Scottish Centre at Glasgow on Tuesday, Lord Weir said there were two common services vital to their future national progress—cheap power and cheap transport. The key to both would be found in cheap electricity. In technical design and construction over the whole field of electrical activity we were now second to none.

T. G. BELL, LIMITED, are vacating their offices at 21 and 22, Bardon Chambers, King Street, Leeds, at the end of the present year, and from January 2, 1924, their address both for office and works will be the Finningley Works, Finningley, near Doncaster. The works now being practically completed, the company are in a position to offer new wagons and colliery pit-tubs, and to carry out repairs to railway rolling stock.

The Foundry Cupola and Mechanical Charging.*

By A. A. Leardet, M.I.Brit.F.

The re-melting of pig-iron and scrap for the production of grey and white-iron castings may be carried out by two distinct types of furnaces—the reverbatory or air furnace and the cupola furnace.

The name cupola was undoubtedly taken from the shape of some of the earlier furnaces, which resembled a dome-shaped building, being gradually tapered away from the centre diameter to that of the top, and in some cases actually closed in.

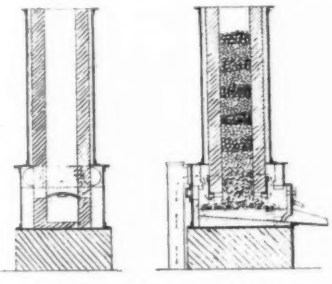


FIG. 1.—KRIGAR'S CUPOLA.

The reverbatory or air furnace does not come within the scope of this Paper; suffice it to say, that it is more generally used where the material to be charged consists of heavy scrap iron which cannot be broken up for charging into a cupola, or where very heavy castings have to be made. The air furnace is more often used in malleable iron foundries. The cupola is also used for melting white iron, and is cheaper to operate than the air furnace, but unless care is taken there is a tendency for the metal to burn.

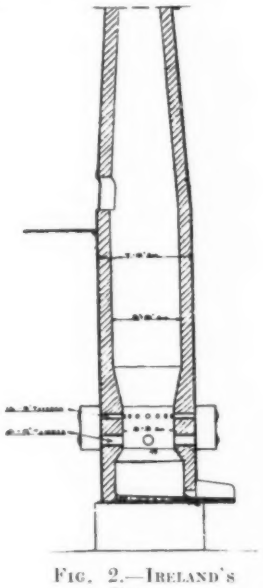


FIG. 2.—IRELAND'S CUPOLA.

The cupola is a shaft furnace, consisting of a vertical firebrick shaft of rectangular, oval or circular section, held together by mild-steel plates. The fuel and metal are charged into the top of the furnace, a blast of air is introduced at the lower end, and the molten metal drawn off at the bottom. This is the simple description of a cupola, and if a furnace were constructed on these simple lines, quite excellent results as regards the quality of the molten metal would be obtained, provided that the operator had a sound knowledge of melting. The problem which faces the designer of cupolas, however, is that of producing a furnace which will melt the most rapidly, produce the hottest metal with the least consumption of coke, and do this consistently and continuously over a reasonable length of time.

The key to the solution of this problem is a knowledge of the amount of fuel which will give sufficient heat to melt a certain quantity of iron in a given time, the necessary amount of air to give complete combustion of this fuel, and the requisite area of hearth in which to burn it.

When looked at in this light, we see there is a close resemblance in this problem to that of the steam boiler builder, who must know what heating surface, fuel, grate area and air are necessary to produce so many pounds of steam per hour.

The cupola builder, however, has a rather more complicated problem than the boiler builder, as he has to know the behaviour of various grades of material under certain heating conditions, whilst the boiler builder is dealing with one standard substance—water.

It is beyond the scope of this Paper to enter into what might be described as "the technology of combustion," but the chemical action which takes place in the cupola under blast requires consideration.

All the oxygen contained in the air blast should be consumed in burning up the fuel, and should

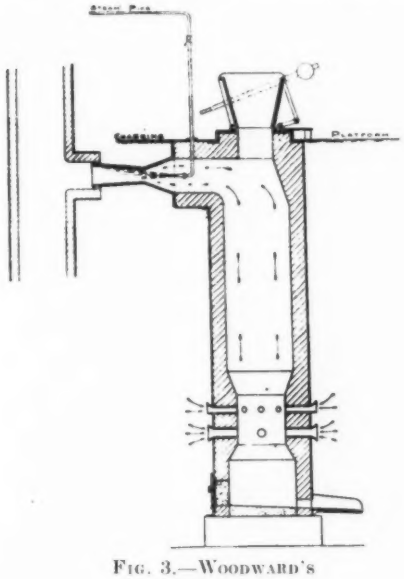


FIG. 3.—WOODWARD'S STEAM-JET CUPOLA.

combine with the carbon in it to form carbon dioxide (CO_2).

Carbon monoxide (CO), a gas which burns in the air with a blue lambent flame, should not be formed, although it is impossible to eliminate it altogether, as the hot CO_2 gas formed in the zone of combustion is bound to pick up some carbon as it passes through the layers of cold coke above, thus forming carbon monoxide. An analysis of the gases at the charging door in a cupola working under correct blast conditions should not show more than about 5 per cent. carbon monoxide and *an entire absence of oxygen.*

Cupola Gas should be Analysed.

The carbon dioxide should be about 16 to 18 per cent. An excess of carbon monoxide indicates an insufficiency of air, or lack of penetration of the blast to the combustion zone, whilst an excess of oxygen shows an excess of blast or bad distribution.

Cupola users would derive much useful information, and in all probability make economies in fuel consumption from this information, if they took samples and analysed the cupola gases at regular intervals. The samples should be taken below the charging door, as naturally, above, the gases are diluted by the air drawn in at this point.

* A Paper presented to the London Branch of the Institute of British Foundrymen, Mr. V. C. Faulkner presiding.

An excessive blue flame burning in the upper portion of the stack above the charging door should immediately arouse suspicion that the quantity or distribution of the air blast is not correct, as it indicates the presence of an excess of the carbon monoxide referred to above.

The combustion of coke when melting iron is set out in Table I.

TABLE I.—*Combustion of Coke.*

1 lb. of average quality coke contains 0.88 lbs. of carbon.

30 cub. ft. of oxygen are required to combust 1 lb. of carbon to CO_2.

∴ 1 lb. of coke requires approximately 26 cub. ft. of oxygen.

Air contains approximately one-fifth of its volume of oxygen.

∴ 1 lb. of coke requires approximately 130 cub ft. of air to complete combustion.

Calculated from the calorific value of the coke and the British Thermal Units necessary to raise 1 lb. of iron to slightly above its melting point, it is found 83 *lbs. of coke* will melt 1 ton of iron.

The necessary quantity of air to burn this coke would be approximately 11,000 cub. ft.

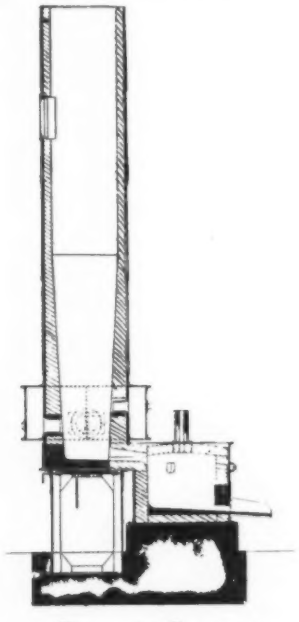


FIG. 4.—THWAITES ULTRA RAPID CUPOLA WITH RECEIVER.

Losses in the Cupola.

1.	Incomplete combustion of fuel	34 per cent.
2.	Loss of heat in ascending gases, radiation and slag ...	6.5 per cent.
3.	Moisture in fuel	3.5 per cent.
4.	Ash from fuel	6.5 per cent.
	Total	50.5 per cent.

Say 50 per cent. Therefore, under these conditions, to melt 1 ton of iron, 166 lbs. of coke would be required and 22,000 cub. ft. of air.

The theoretically perfect figure should be noted and considered in conjunction with some of the extravagant claims made by some cupola makers and users as to fuel consumption.

These ideal conditions can never be realised in practice; as has been shown, the coke is only burnt partially to carbon dioxide, heat is lost through the chimney of the cupola and through the slag hole, water is often present in the coke, heat is lost in the slag, and general radiation is taking place.

It is not unreasonable to assume that the total of these losses would reduce the efficiency of the cupola to about 50 per cent., by far the greater loss occurring from the incomplete combustion of the fuel, showing that this is the most important factor in determining the efficiency of a cupola. Hence a cupola having a 50 per cent. thermal efficiency will consume 166 lbs. of coke for every ton of iron melted, a result which is rarely, if ever, achieved in actual practice.

Returning again to the question of the necessary air to burn this amount of coke, we find that 18,200 cub. ft. is required. These figures are purely theoretical, and we shall see later from practical examples actual quantities of fuel and air which are used.

Early Forms of Cupolas.

Fig. 1 illustrates an early type of cupola rectangular in form. It was generally known as Krigar's cupola, of German origin, in use about 1860. The shaft was made oblong or square in section and parallel in length. A backing of sand is used between the brickwork and shell, to assist in preventing radiation. This brickwork is supported at the front and back by arches over a lower chamber or well. Around the bottom of the shaft and over these arches is arranged the air passage, into which air is delivered by two mains. The air, entering this passage, cools the brickwork and also becomes heated by being in contact with it. The air passes down into the melting chamber through two long slots in the roof extending right across the width of the hearth.

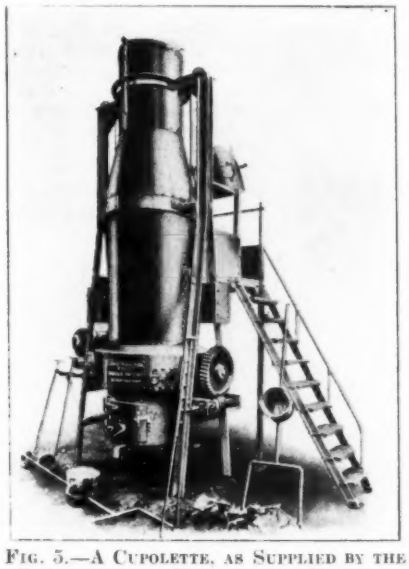


FIG. 5.—A CUPOLETTE, AS SUPPLIED BY THE CONSTRUCTIONAL ENGINEERING COMPANY.

The front of the cupola is closed by an iron door on hinges; a smaller door is placed at the back.

The charging of this cupola appears to have been very similar to the present-day practice. One having a capacity of 3 tons per hour requires a filling of 2¾ cwts. of coke for starting it, then a charge of 8 cwts. of iron, then ½ cwt. of coke, and so on alternately. The average quantity of coke consumed was 1½ cwts. per ton of iron melted, based on a total blow of 3 tons and as low as 1¼ cwts. for blows over 6 tons. These particulars have been taken from a description of this German cupola, read before the Institution of Mechanical Engineers in 1868. The author can only surmise that, as this date was previous to the introduction of by-product plants in connection with coke manufacture, the coke was far better in quality, or perhaps the iron was more easily melted, or, again, the cupola manufacturers of that day were even more optimistic in their statements of coke consumption than they are to-day. This cupola has, in the author's opinion, one fault in design which cannot lead to economy of fuel consumption, the blast coming through the air passages not only abstracts heat from the brickwork, but also from the metal itself contained in the well at the bottom. Any slight advantage that may be obtained by the increased temperature of the blast must be outweighed by the chilling of the metal.

It is interesting to note that more recent de-

signs of cupolas constructed by the same German —Krigar of Hanover—almost invariably include a forehearth or receiver, while the tuyeres are arranged radially in a single row around the walls of the cupola, slightly above the point where the metal flows into the receiver.

Another of the early forms of furnaces was known as Ireland's cupola. In its original design, this cupola was constructed with a bosh underneath the melting zone, of a larger diameter to give an increased capacity for liquid metal. It had two rows of tuyeres, one row being just above this bosh and the other near the base of it. Later designs of this cupola are very similar to modern practice. Fig. 2 shows in diagrammatic form particulars of two 7-ft. diameter cupolas of Ireland's design which were used in 1866 for casting a large anvil-block weighing 205 tons. Actu-

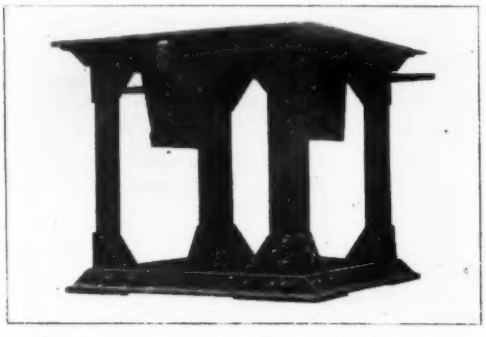


FIG. 6.—SHOWING ALL-STEEL DROP BOTTOM.

ally, 220 tons of metal were melted by the two cupolas in 10¾ hours; the coke consumption was only 1¼ cwts. per ton of iron melted. The blast pressure was 14 ozs.

Analysing the figures and dimensions, we find that each cupola melted approximately 10 tons of metal per hour, the hearth area approximates 160 sq. in. per ton per hour, and the tuyere area is one-fifth of the hearth area.

These figures are very little different from those adopted as a standard by some makers to-day. The author is of the opinion that an improvement in the melting performance would have been obtained by increasing the tuyere area.

Although a common present-day empirical figure is 10 lbs. of iron per hour for every sq. in. of hearth area, equivalent to 224 sq. in. per ton, yet it has been proved very conclusively from

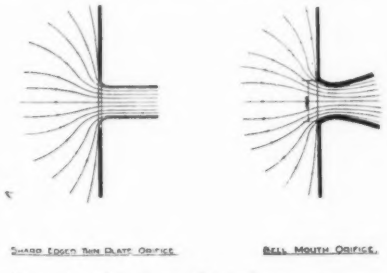


FIG. 7.—SHOWING ORDINARY AND *vena contracta* TUYERES.

actual tests taken that this can be greatly improved if the proportion of tuyere area is increased. For cupolas of medium and large capacity, say from 4 tons per hour and upwards, the hearth area may be safely taken at a minimum of 150 sq. in. per ton per hour, with a tuyere ratio of not less than one-third, that is, 50 sq. in. of tuyere area per ton per hour.

Steam Jet Cupolas.

Cupolas have been worked with a steam jet to create an induced draught. Fig. 3 shows the arrangement of one known as Woodward's steam-jet cupola. It was claimed for this cupola that it was economical in coke consumption, and that the steam used was no more than that required to drive a fan or blower for ordinary blast. The air is drawn in through openings placed radially like ordinary blast tuyeres. These can be controlled from the outside by the closing or partial closing of a hinged cover over the opening. The author has not been able to obtain any information as to the actual performance of one of these cupolas. It is obvious, however, that, as the actual pressure of air inside this cupola will be less than that of the atmosphere, there would be a danger of air leaking in at various points of the cupola chimney, through badly-made brickwork, causing bad combustion of the fuel. The fact that the charging door would have to be more or less hermetically sealed after each charge, appears to break down any claim of simplicity in

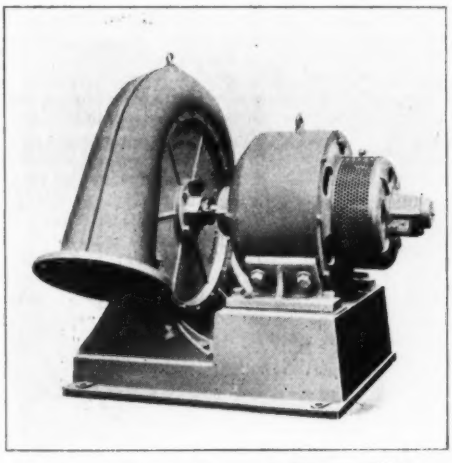


FIG. 8.—A KEITH-BLACKMAN FAN AND MOTOR MOUNTED ON THE SAME BED.

design, which might be made owing to the absence of blowing apparatus and connections to tuyeres.

The modern cupola is almost invariably of the vertical type, having horizontal tuyeres in one or more rows near the bottom of the furnace. The majority of makes are fitted with an air belt for the distribution of the blast to the tuyeres, usually arranged so that these open directly into the air belt. An examination of the proportion of hearth and tuyere area in the various makes of

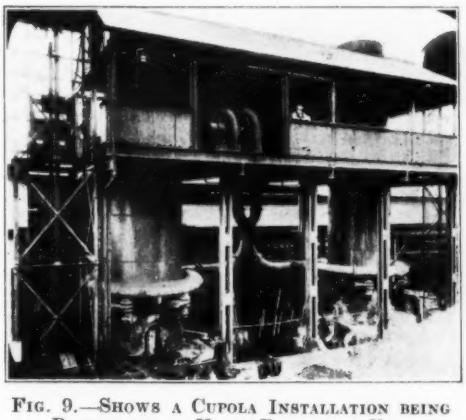


FIG. 9.—SHOWS A CUPOLA INSTALLATION BEING DRIVEN BY A KEITH-BLACKMAN FAN.

cupolas reveals a complete absence of any general standard.

Four well-known makes, each having a nominal capacity of 4 tons per hour, were recently examined by the author, with the astonishing differences shown in Table II.

TABLE II.—*A Comparison of Four Types of Cupolas.*

	Area of hearth per ton.	Area of tuyeres per ton.	Ratio hearth tuyeres.
A,	220 sq. in.	25 sq. in.	8.8
B.	265 sq. in.	56.25 sq. in.	4.7
C.	180 sq. in.	14 sq. in.	27.1
D.	150 sq. in.	50 sq. in.	3

The last, as will be gathered from a previous statement, is the standard now adopted by the firm with which the author was connected.

Fig. 4 shows the Thwaites Ultra-Rapid cupola, fitted with a receiver, and Fig. 5 a Constructional Engineering Company's cupolette. This plant is designed to give small quantities of very hot metal, such as in bedstead foundries. It can be tilted for repairs, and the tuyeres can be regulated by quadrant levers, giving the furnaceman an increase of control which could not otherwise be obtained.

Receivers.

There is a great deal of diversity of opinion regarding the advantage of using receivers. The author has found it the best plan to leave the decision as to whether a receiver should be fitted or not to the prospective user, after having pointed out what, in his opinion, are the advantages. Where the practice in the foundry is to take small quantities of metal from the furnace continuously during the process of melting, then there is no advantage in having a receiver. If, however, the work is of a varying nature, heavy and light castings with variations in the mixture, then a receiver is undoubtedly an advantage. The receiver takes the place of a large ladle placed in front of the cupola, with the great advantage of having the hot gases from the cupola constantly playing on to the surface of this metal and maintaining it at its original temperature. Better mixing of the metal is thus assured, and the molten metal does not remain so long in contact

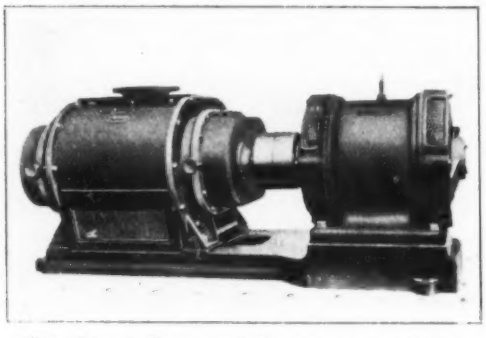


FIG. 10.—A THWAITES' DIRECT-COUPLED HIGH-SPEED MOTOR-DRIVEN BLOWER, FITTED WITH HOFFMAN ROLLER BEARINGS.

with the coke. The bosh of the cupola itself may be very much smaller, as it is not required to store molten metal, which means an economy in the coke necessary to form the bed. The likelihood of slag getting into the tuyeres is also absent, as all slagging is carried out in the receiver itself, the melting therefore is very much cleaner. The usual method in a foundry having a cupola and receiver is to cast a fairly heavy section casting first, one not requiring very hot metal, as the receiver certainly has a tendency to chill the first metal. The hand-shank work can be cast up at the end of the blow. In fact, metal can be taken from the receiver for some considerable time after the blast has been shut off, and the process of removing the charge from the cupola proceeded with.

Drop Bottoms.

A cupola fitted with a drop bottom is undoubtedly a great time saver, at the end of the blow, as the whole of the charge may be dropped on the floor within a few minutes of the blast being shut off. It also greatly facilitates the patching up of the lining around the tuyeres, as the operator can stand inside the cupola. On the other hand, additional work is required in making up the bottom after every blow. The risk of metal coming through the drop bottom doors is infinitesimal if the making up is properly done.

Fig. 6 illustrates the all steel drop bottom, which is a feature of the design of the cupola made by the firm with which the author was connected.

Coke Consumption.

It has already been shown that in a cupola working at 50 per cent. thermal efficiency the coke consumption would be approximately 166 lb. to the ton of iron melted. Large cupolas working over long continuous periods have come out with a consumption of slightly over 1¼ cwt. per ton, but the average iron foundry cupola of medium capacity, say, 5 to 6 tons per hour, over blows of three hours duration, rarely, if ever, gives such results. There is a very great difference between the results which can be obtained on a specially conducted test, where the closest attention is paid to all details, and those obtained over a period under working conditions. It is not safe to base calculations of melting costs on a less figure than 2 cwt. of coke per ton of iron melted, including the necessary bed charge. This is undoubtedly the amount of coke which would have to be paid for by the foundry owner, and after all, that is the most important point. If, on the other hand, the coke consumption is higher than this, there is something wrong somewhere, as from what we have already seen it means that the melting plant is working at less than 30 per cent. efficiency. It should be understood that these figures regarding coke consumption are based on the melting of the ordinary mixtures met with in grey iron foundry practice. Hematite and white iron both require more fuel to melt.

Blast and Tuyeres.

To return once more to the question of the consumption of fuel, we see that a cupola running at 50 per cent. thermal efficiency required 22,000

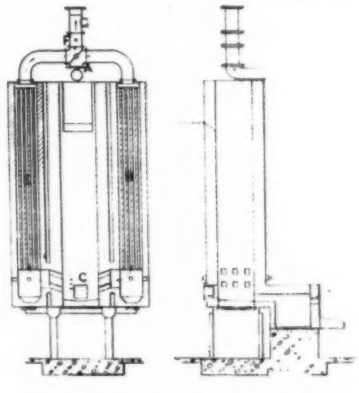


FIG. 11.—A HOT-BLAST CUPOLA OF GERMAN DESIGN.

cub. ft. of air for every ton of metal melted. The rating of a cupola is generally expressed as so many tons per hour, therefore this cupola will require for each ton 22,000 cub. ft. of free air per hour, or 365 cub. ft. of free air per minute. It has also been shown that in practice foundry cupolas are rarely met with working at so high an efficiency. It is usual to allow from about 400 to 500 cub. ft. of free air per min., varying inversely with the size of the cupola. This amount of air must be delivered in such a way to the cupola that it is evenly distributed through the burning coke to effect as nearly as possible its perfect combustion. In other words, its velocity must be such that it is not too great thereby forcing the melting zone too high up the cupola, nor must it be too slow to trickle up the sides of the cupola, causing carbon monoxide to burn in the higher parts of the charge. It will be noticed in these conditions not a word is said about the pressure of the blast. Air pressure is only a necessary evil to force the desired quantity of air through the charge—it only indicates the velocity, and this is the only useful function it performs in connection with cupola melting. If the velocity could be obtained without pressure, it would save a very vast sum in the cost of the power taken to create the blast. Foundrymen have to do work and pay for power to compress the air only to let it expand again inside the cupola. It is very evident, therefore, that to obtain economical working the pressure must be kept as low as possible without reducing the velocity too much.

The resistance to the passage of the air through the cupola is made up of (1) the burden of the iron and fuel charge in the cupola; (2) the friction

of the air passing through the tuyeres and (3) the friction of the air passing through the pipes and passages between the blower and cupola. The burden of the iron and fuel must exist, and we cannot alter it, therefore the cupola designer must confine his attention to the reduction of resistance in tuyeres, pipes and passages.

The author has already pointed out that from his experience a total tuyere area of approximately one-third of the hearth area is not too great, and with the correct quantity of blast gives the correct velocity. Tuyeres may be circular or oblong, but the chief essential is that they should be bell-mouthed on the air belt side (Fig. 7), and also increase in cross sectional area as they enter the cupola. This forms what is called a *vena contracta* orifice, which will pass any given quantity of air with the minimum amount of resistance. In addition, this shape gives a good spreading effect to the blast inside the cupola. Pipes and passages can be dealt with by keeping their cross-sectional area large, avoiding sharp bends in the pipe line and keeping the blowing unit as near to the cupola as practical.

A water gauge reading taken at the cupola air belt, and also at the outlet of the blower, would in some foundries which the author has visited show such a difference that the users would be astounded at the amount of money they were daily throwing into the blast main in the form of wasted power.

Disposition of Tuyeres.

The author believes in having two rows of tuyeres in a cupola, preferably with control valves on the top row; this arrangement gives a better distribution of blast and enables a better control to be maintained on the melting, especially in the later stages when the cupola is very hot.

A word on the vexed question of semi-positive blowers versus centrifugal fans. Although it may be considered that the author may be prejudiced on this subject, he maintains that for correct melting conditions a positive or semi-positive blowing apparatus is an essential. All the arguments advanced in this Paper for successful cupola operation are based on correct fuel consumption, in its turn entirely dependent on the correct quantity of blast.

Blowing Apparatus.

The only blowing apparatus which is entirely capable of supplying a known quantity of blast under varying conditions of resistance is the old-fashioned reciprocating blowing engine. The machine which comes next in order of merit capable of doing this is the Roots blower. The blowing engine is cumbersome and has the disadvantage of creating a pulsating blast, but still it can measure out the same volume revolution by revolution independent of anything that is happening in the cupola.

The volume from a Roots blower running at constant speed varies but very little following variations in resistance. At the usual speed at which it is run the pulsations of the blast are hardly perceptible. The centrifugal fan produces the pressure, or velocity of the air, by the speed of the circumference of the disc, so that if its speed is constant any reduction in the resistance of the cupola immediately causes an increase in the volume of air, while any increase in the resistance rapidly reduces the volume delivered, a condition most undesirable for consistent melting.

Electrically-driven fans working on a direct current supply are so arranged that any falling off in the volume of air automatically brings about an increase in speed. This overcomes the difficulty to a certain extent, but this cannot be accomplished with the belt-driven type.

The author is aware that there are many installations working satisfactorily with centrifugal fans, so he advances his opinions with a certain amount of deference, although with none the less conviction. Fig. 8 shows a Keith-Blackman fan and motor mounted on the same bed, and Fig. 9 a cupola installation being driven by this method.

The latest development in Roots blowers, building them throughout on precision roller bearings, enables them to be run at much higher speeds, so that much smaller machines are now installed for any given duty, whilst the higher speed gives increased efficiency. Fig. 10 shows a Thwaites direct-coupled high-speed motor driven blower. It is fitted with Hoffman roller bearings. The machine is totally enclosed. The smaller sizes of these machines can run up to 1,500 r.p.m.

Hot Blast Cupolas.

Whilst dealing with the question of blast it might be as well to refer to hot blast for cupolas. Several attempts have been made to introduce this, but with little success, as the average foundry cupola remains such a comparatively short time in blast that any heat that is imparted to the blast only produces an effect towards the end of the blow. It is obvious that if a satisfactory and reliable hot blast cupola could be devised, an improvement would be made in the thermal efficiency of the cupola.

Fig. 11 illustrates a hot blast cupola of German design. It incorporates an arrangement similar to a Cowper regenerator for blast furnaces.

This cupola apparently works approximately 10 hours continuously per day, and it is claimed that the coke consumption does not exceed 145 lb. per ton, which means a thermal efficiency of over 60 per cent.

Analysis of the waste gases gave 5 per cent. CO and 14 per cent. CO_2, almost the ideal analysis laid down at the beginning of this Paper. The cupola is 36 in. internal diameter, melts 5½ tons per hour, giving a hearth area of 180 sq. in. per ton and is supplied with 2,650 cub. ft. of air per min. or 480 cub. ft. per min. per ton per hour.

Book Review.

Fencing and Other Safety Precautions for Woodworking Machinery. Issued by the Home Office, and published by His Majesty's Stationery Office, Imperial House, Kingsway, London, W.C.2. Price 1s. 1½d. post free.

This brochure should be obtained by every foundry which has its own pattern shop, as it contains many practical hints for ensuring the safety of woodworking machine operatives. Both home-made and proprietary types of guards are illustrated and described. Circular saws, rebating machines, planers, band saws, mortising machines, and frame saws are dealt with and practical devices explained for ensuring their safety. A further section is devoted to pneumatic dust-removal systems. There are included two appendices, the first of which outlines the "Woodworking Machinery Regulations, 1922," and the second "First-aid Arrangements at Saw Mills and Factories in which Wood Articles are Manufactured."

Catalogues Received.

Engineering Products. — Messrs. Crossley Bros., of Openshaw, Manchester, have sent us a handsome brochure entitled "Crossley Productions." Its object is to outline the various machines manufactured by the firm, which range from small portable gas engines to 30-h.p. automobiles. Tractors, motor road-rollers, blast-furnace gas engines are typical of the output of the Crossley organisation.

Foundry Supplies.—The "Pneulec News" for December includes a special notice of pneumatic electric riddles.

Lubrication.—"Lubrication" is the house organ of the Texas Company, 17, Battery Place, New York City. Number 8, volume 9, contains articles on the lubrication of driving chains and road-making machinery.

Institute of Metals.

The annual general meeting of the Institute is to be held in London on March 12 and 13 at the Institute of Mechanical Engineers, the annual dinner being held on the first night. The "May" lecture is to be given by Dr. F. W. Aston on June 4, in order that it can form part of the Empire Congress of Mining and Metallurgy. On Tuesday last a meeting of the London Section was held at Burlington House, under the chairmanship of Sir John Dewrance, to examine the possibilities of holding the autumn meeting in London. A strong committee was formed to inquire whether the difficulties could be overcome. Sir John Dewrance has promised to preside, and Mr. A. H. Mundey is acting as hon. secretary.

XUM

An Apprenticeship Course in Foundry Practice.—LXIX.

By Ben Shaw and James Edgar.

TECHNICAL TRAINING.

Having come to the end of what we may justly claim to have been a very comprehensive series of articles dealing with almost every phase of foundry practice, it is but fitting that in this concluding article we should take our readers to one side, as it were, and discuss with them in what way they may best qualify for the great opportunities which the foundry industry will offer in the future to clever and well-trained men. Foundry work has become so much a science that the rule-of-thumb managers and foremen of the old days have almost all given place to men with technical qualifications, either obtained at schools of technology or by persistent home study. The object of these articles will have been achieved if our apprentice readers have become imbued with the lofty desire to further the interest of the industry, and, whenever the occasion presents itself, to conduct experimental work that may result in the perfecting of castings. Every foundryman is in some measure a research worker, and there is no other occupation in which there is greater opportunity for the display of originality. The foundry is being regarded to-day by many as a laboratory on a large scale. There will always be the need for the pure manual worker, but the division between this sort of foundryman and the man who has a good understanding of the technical principles of his craft is becoming more clearly defined every day. To achieve success more than mere manual skill is necessary, and organising skill is not sufficient. It is sometimes said that the foundry gets the wrong type of boys, that youths from public schools and secondary schools gravitate to the drawing office. There is a modicum of truth in this, but we should like our readers to think that they, at least, are the right type. Every lad, however limited his educational opportunities may have been, has the facilities at hand for self-improvement. The day has long passed when it was reasonable for young men to complain of being handicapped by insufficient education. The men of mark in the foundries at the present time are in many cases men who had a very imperfect education in early days. Instead of complaining about their education let the readers of these articles take heart from efforts that are being made to induce better educated lads into the foundry because, as things are now, the field is at least perfectly fair, and this applies almost equally to steel, iron and non-ferrous foundries.

The Chemist's Part.

The time was when very few foundries thought a laboratory an advantage. We have seen laboratories fairly well equipped used as storerooms. Even to-day only the largest foundries can afford to keep chemists. Yet the chemist's part is now recognised as so valuable that the question of co-operative laboratories is often seriously discussed. This, in fact, is what the two British research associations for the foundry trades really are. Not all foundrymen are friendly to the chemist. There is a disposition sometimes even to-day to regard him as an interloper. That, presumably, is because of the influence he wields. The lesson the apprentice should learn from the chemist's importance is that chemistry is a subject of the greatest value, and consequently worthy of much time being spent on it. If the apprentice feels that his general education is so faulty that science is far beyond him, it is his duty to himself, by study, to improve this. The only way the foundryman can prevent the incursions of the chemist is to become a chemist himself. This many foundrymen have successfully done, and many of our most distinguished foundry chemists have graduated from the foundry floor. There is no reason why chemists should monopolise the higher positions. A foundryman without a knowledge of chemistry is at a disadvantage, but not more so than the chemist without a practical knowledge of moulding and general workshop practice. The best man is undoubtedly he who has a knowledge of both theory and practice. The apprentice must not suppose that metallurgy is the only concern of the foundry chemist. There is great scope for original research with sands. Much work has been done during the last few years, but so much yet remains to be done that sand research may be almost described as virgin ground. There is no lack of facilities for acquiring a knowledge of chemistry. In every town in the United Kingdom are evening classes.

Geometry and Machine Design.

Almost, if not quite, as important as chemistry is a knowledge of geometry and machine design. Especially is this so if we regard the foundryman as a man who is responsible for both pattern-making and moulding, and the tendency now is to do so. It may not be possible for one man to obtain the comprehensive knowledge of woodcraft and engineering subjects that is essential before a man can call himself a first-class patternmaker, and at the same time master the theory of moulding-shop practice, but the best foundryman is that man who has been fortunate in getting a knowledge of both patternshop and moulding-shop practice before specialising in one or the other. If a knowledge of geometry did nothing else it would be an aid when reading drawings. But if the foundryman has charge of the patternshop it is indispensable for several reasons. He may not have to set down work, but constructional difficulties are more fully appreciated, and therefore the need for simplification of design. Every experienced man knows that while the foundryman—moulder or pattern-maker or both in one—is not a designer he is frequently consulted, and when not consulted he has often to tender advice to the drawing office. The man with a knowledge of geometry can the better calculate the labour and material costs of a pattern and core box. As to machine design, this is just slightly less important than geometry—some may even say that it is more important. The foundryman should certainly obtain some general knowledge of engineering. Those foundrymen who do not obtain this knowledge in a systematic way invariably pick it up in a desultory way in the course of years. It helps to solve problems concerning metal thicknesses and strengths and also necessary machining allowances.

Foundry Classes.

The modern apprentice is fortunate in being able to attend foundry classes in the evening, and his hours in the workshop being short there is no excuse for not doing so. Apprentices are often reluctant to attend classes, which they regard as virtually "overtime," and this may be the reason why some foundry classes have to be abandoned every winter. At the evening class, however, as different from the workshop, they learn the reason for doing certain things. They also, in many cases, are initiated into melting practice, and not all apprentices get an opportunity of learning anything or much about the melting of metal in the workshop. The foundry class also breaks down that stupid barrier that divides moulder from core-maker. It is surely deplorable that moulding-shop labour should be divided into two distinct divisions. There is much to learn in moulding, and also in core-making, but while it is necessary for production purposes that men should be restricted to one or the other, the most valuable craftsmen are men who have had experience at both core-making and moulding. In the evening class the apprentice core-maker learns something of moulding and the moulder of core-making. It is probable, also, if he is engaged during the day on green-sand work that he will get an insight into loam

work at the evening class. In the case of the apprentice patternmaker, if he can go into a foundry during his working day the experience he obtains at a practical foundry class cannot be overestimated. Patternmaking classes are equally valuable. In some foundries and patternshops there is no loam or skeleton work, and the evening classes may give experience in this. There is an unfortunate tendency with some otherwise excellent teachers to concentrate on the class of work peculiar to the district in which the class is held, but if a pupil evinces a desire for a broader knowledge the teacher is usually willing and able to assist him. If the apprentice has, at some time during or shortly after his apprenticeship period, the time and opportunity to attend a class in general machine work he will never regret it. Such practical knowledge of the finishing of castings may be a luxury, but it is of great usefulness.

It is very probable that before many years pass most technical schools will have curricula on foundry work spread over about four years, consequently the youths who are going through the workshops at the present time must anticipate that competition for the higher positions in the industry will become gradually keener. The attractions of the work will also ultimately appeal to secondary school boys. The apprentices who are going through their probationery period now, therefore, should make their own curriculum.

Correspondence Classes.

Correspondence classes have developed to such an extent and become so important a feature of our educational system that we cannot affect to ignore them when considering the education of young foundrymen. Correspondence classes undoubtedly have filled a want. They perform a useful function in providing facilities for those who live in districts where attendance at oral classes is impossible. A great drawback of the correspondence class is the lack of personal contact between teacher and pupil, and also the fact that there is no practical tuition. There are undoubtedly compensating advantages, one of these being that the student retains a copy of each lecture and at oral classes much of what the teacher says is lost through bad note-taking. It is wrong to regard the correspondence tuition as a quick road to knowledge as some do. Fairly considered, the student of the correspondence class must have greater pertinacity to acquire a good knowledge of the subject being studied. There is more temptation to procrastinate, and whenever an apprentice has the choice between attending oral classes and joining correspondence classes he should decide in favour of the former course. This, we know, is a very contentious point, and by favouring oral tuition we invite criticism, but the above opinions have been expressed after grave consideration and with experience of both oral and correspondence tuition to guide us. It is sometimes possible to combine the two methods, because it may only be possible for the student to attend certain oral classes, and he should then supplement these with correspondence.

The Technical Press.

It is right that tribute should be paid in such an article as this to the splendid service rendered to the foundry industry by the technical Press of this country. These journals are a gold mine of information. The apprentice cannot read too many journals and compare the experience of writers with their own ideas. Not the least value of technical papers is that they publish reports of the proceedings of technical societies. In addition the correspondence columns constitute a forum for discussion. The readers include many practical men who are prepared to place their experience at the disposal of other readers and thus, if the apprentice is perplexed, he can always obtain advice. In case this paragraph catches the eye of any foundry employers, we make the suggestion that they should endeavour to interest their apprentices in technical literature. Some employers have instituted classes for their apprentices which are held during the ordinary working hours, and it is surely not too much to ask and urge those who cannot afford to do so to invite boys to read the technical press.

Technical Societies.

Classes and journals are important but as important are technical societies. Such an association as the Institute of British Foundrymen has rendered great service and it is an unequalled training ground for young men. Not only are the various papers the work of experts, but the discussions that follow their reading are of even greater value in many cases. The apprentice also comes into intimate contact with enthusiasts at their business, and there is nothing more infectious than enthusiasm. It should be remembered also that membership of technical societies gives a status. It is something more than a label; it is a proof that a man is something more than a mere manual labourer.

Home Experimental Work.

In a fairly long experience we have only known one or two men who realised what could be done at home by way of experimental work. Technical classes have been eulogised in this article, and laboratory experience is not difficult to get, but there is no reason why, with practically no apparatus, interesting, if simple, work of a research nature cannot be conducted at home. We know of one man who has, merely to satisfy a craftsman's curiosity, done a good deal of experimental work with dry-sand cores in a small shed. And this at small expense. Patternmakers who cannot, in the daytime, obtain experience of tooth gearing or propeller work, can easily learn all they need know until they get an opportunity for wider experience. In patternshops where the boys do not get an opportunity to set down work they can learn to do so quite well at home.

The Rewards.

Some cynically-minded readers may exclaim that the rewards for hard study and endeavour are not worth while. That depends upon many things. There are those enviable people to whom achievement is sufficient reward. There are others who work solely with a view to material gain. It may be admitted quite frankly that all cannot win material success. Some do so—not always the more fortunate—and others have to regard the happiness that comes from greater knowledge as their reward. But there are some big prizes and all have an opportunity of winning them. The fear is expressed occasionally that the foundryman's craft will ultimately become a series of stereotyped operations, that it will become almost altogether a machine operation. Presumably this fear has arisen because of the wonderful development of moulding-shop machinery, but the fear is unfounded.

Book Reviews.

Report of the Commercial Situation in Indo-China. By F. G. Gordon and H. F. C. Walsh (respectively His Majesty's Consul-General and Vice-Consul at Saigon). Published by His Majesty's Stationery Office, Imperial House, Kingsway, London, W.C.2. Price 9½d., post free.

"High preferential tariffs on French goods make it almost impossible for foreign countries to compete with French manufacturers in Indo-China." This quotation from the Report does not encourage foundry owners to investigate what is a flourishing market, as France can make all the castings required, both raw and worked up, equally as cheaply as the British manufacturer.

Report on the Economic Conditions in South Africa. By W. C. Wickham (H.M. Senior Trade Commissioner in South Africa). Published by H.M. Stationery Office, Imperial House, Kingsway. Price 1s. 7d., post free.

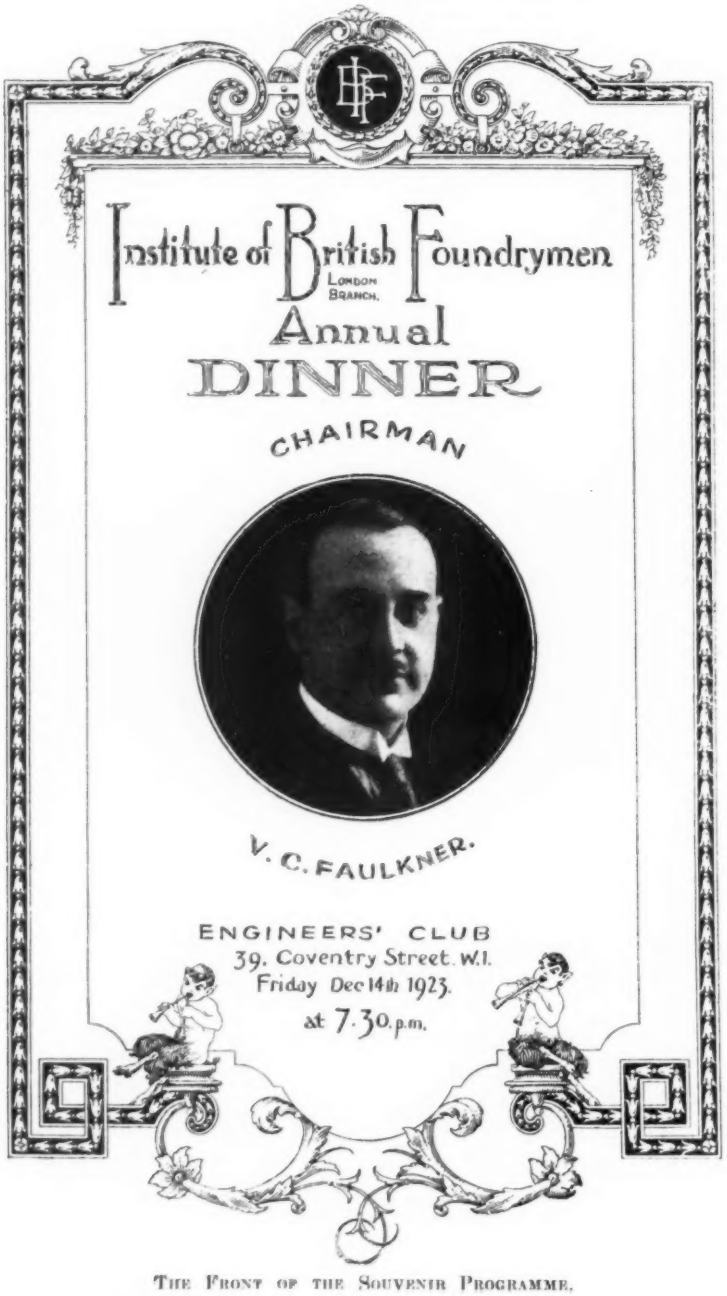
The Report has direct interest for foundrymen, as South Africa is a large market for their goods, especially cast-iron pipe, parts of mining machinery and building castings. It is interesting to note that in the case of iron and steel manufactures (pipes, bars, galvanised iron, etc.), importation increased from 53,000 to 84,000 tons, but the fall in price being so great that the large tonnage was valued at £200,000 less.

According to the report, Germany has supplied 2-5 of the rails, ¼ of the plates, and nearly half the iron and steel pipes, a matter of 2,000 tons of cast-iron and steel pipes.

Institute of British Foundrymen.

London Branch.

The annual dinner of the London Branch of the Institute of British Foundrymen took place on Friday, December 14, at the Engineers' Club, Coventry Street, London, Mr. V. C. Faulkner (Branch-President) occupying the chair.



THE FRONT OF THE SOUVENIR PROGRAMME.

Modern Industrial Conditions.

SIR WILLIAM LARKE (Federation of Iron and Steel Manufacturers) proposed the toast of "The Institute of British Foundrymen." He said the toast was a great responsibility, and he must deal with it with a sense of that responsibility. He was going to deal with an interesting story. Very briefly, it was that of their own Institute. When he was asked to accept the responsibility for the toast, he took some trouble to try and understand what the Institute was doing, and how it was doing it. It had been his fortune to belong to a number of Institutes, and he said without any flattery that this Institute had more nearly achieved the objects it claimed to achieve than any other of those to which he belonged. The foundries had their technicians and their practical men. He had spent years in trying to reconcile the views of the technicians with those of the practical men in the shops. That reconciliation was sometimes quite difficult, and his experience enabled him to say definitely that the reason there was any difficulty in reconciling the two views was that neither side was anxious to hear the other to an end. He was delighted to find the real object of the Institute was to bring the practical and technical men together, and he was pleased to hear that they succeeded in bringing them into a complete harmonious relation, with a result that must be of vast importance to the industry itself. He wished to bring to his hearers' minds an aspect of that present situation which he thought was too little regarded. They were living to-day in a commercial world that was entirely different from what it had ever been before. Commercial conditions were entirely different from what they had been in pre-war days. International trade

was completely suspended during the war, but he met many people who thought, now peace was signed, the 1914 days would return automatically and that they had only to go on in the same old way. It was not so. They had not only to re-establish their overseas markets, but to develop their capacity for competition for international trade to a degree they had never experienced before. That was where that Institute came in. He found they had an Oliver Stubbs Medal, and he was very much impressed by the fact. He had not only that civic sense of responsibility that they all owed to the community amongst whom they lived and worked of doing something for the common weal, but he evidently had a flair for public affairs. The endowment of the Oliver Stubbs Gold Medal was a great compliment to his public work. He could not conceive a higher compliment than that which had been given to Mr. Stubbs' work in the National Ironfounding Employers' Federation, and the Institute of British Foundrymen was to be complimented upon

A NEW CRANE.
ARE WE DOWNHEARTED?
TO MAKE PERFECT CASTINGS THIS MIXTURE REQUIRES LARGE FEEDING HEADS.
DOGS ARE USED FOR TRANSPORT IN BELGIUM. WHAT ABOUT THIS?
THERE'S AIR— NOT COMPRESSED
O'YEZ! IS TRADE GOING TO BE WORSE IN 1924 OH NO!
"BONZO" ON WASTERS
CUPID'S MELTING POT.
IT CERTAINLY WAS NOT THE MOULDER'S FAULT — WAS IT THE PATTERNMAKER'S OR

THE BACK OF THE SOUVENIR PROGRAMME.

wished to refer to the object of this endowment. It was to encourage and reward the efforts made by the members of the Institute of British Foundrymen to impart knowledge to their fellow-members on the practice and theory of founding. With regard to what he had said about developing our national ability and resources and increasing our national trade, he could conceive of nothing better than the object of that gift, the encouragement of improved methods in foundries. That brought him to Mr. Stubbs, who, it was evident, having been made the stewards for that endowment for the encouragement of its members. He was pleased to know that the Institute had been recognised by His Majesty's Privy Council by the grant of a Charter of Incorporation. He wished the Institute every possible prosperity in the future. He understood the President-Elect was Mr. Patterson, and he was confident, from what he knew of the achievements of his firm and what he heard of him personally, that the traditions which had been established and kept at such a

high standard by Mr. Stubbs during his year of office were safe in the care of the President-Elect. The Institute now had a membership of 1,600 throughout the country. This, he understood, was a London function. He dared say the gentlemen who had come from a distance to honour that function had the impression that the Londoners were apt to think they were the centre of things, but he had lived for 20 years in the provinces, and found that in the provinces they did things, and the people in London talked about what they had done. If that was the case, the provincial members would not grudge the Londoners their little bit of "side" in thinking they were the centre of things. He gave them the toast of "The Institute of British Foundrymen." Might it ever flourish and its members continue to increase. He coupled with the toast the name of Mr. Oliver Stubbs.

The Institute and International Co-operation.

MR. OLIVER STUBBS (President of the Institute), replying to the toast, thanked Sir William Larke for the gracious manner in which he had proposed it. At the same time, he did not think it was necessary to have picked him (Mr. Stubbs) out as being any more responsible for carrying on the work of the Institute than other friends round the table. Their success was due to the fact that they had such a splendid team of workers. It was the most humble men in the foundry that they wanted to get hold of, and the more they got of them, the greater would be their success. There were many reasons why they should be grateful as regarded their Institute. They were the first movers in the International Congress and Conference which was held in Paris, and they felt proud that they were the first body to move in the direction of obtaining an international specification for grey-iron castings. They were also moving on the question of buying pig-iron by analysis. Mr. Fletcher would bear him out when he said: "If you want to buy pig-iron to analysis, for goodness sake do not ask for fracture as well." A friend showed him pig-iron which he had bought by analysis as No. 3, and said: "It is not decent forge—look at the fracture." He found he had to use it more sparingly than his No. 3, as the castings would otherwise have been too soft. The Institute was gratified that the visit of the American delegation to this country was so successful. Great credit was due to the London Branch for the splendid send-off they gave them. It was one of the most delightful times they had had to entertain their American friends while they were over here. Many members of the Institute made friends whom they hoped to retain as long as they lived. They had had charming letters of thanks from their American friends, and he had a telegram from President Clamer, of the American Foundrymen's Association: — "Philadelphia, November 21, 1923. Oliver Stubbs, 'Winding,' Manchester. Board of directors, American Foundrymen's Association, meeting to-day, send greetings in appreciation for great hospitality extended by British Institute of Foundrymen to delegation our Association on recent tour your country.—G. H. Clamer."

He had been asked whether he was in favour of protection. He did not believe in a small subscription—letting people come in and get a great deal for nothing. That was his form of protection as far as the Institute of British Foundrymen was concerned. He wanted to say this to the London men. He had had many occasions on which their President (Mr. Faulkner) had been a valuable help to him, and he wanted to give him a little presentation in appreciation of those services. Mr. Stubbs then presented Mr. Faulkner with a gold fountain pen, and concluded by thanking those present for the generous way in which they had responded to the toast.

The Buying of Castings.

MR. H. O. SLATER (Past Branch-President), proposing the toast of "Allied Industries," said he did not feel quite at home when he was asked to propose the toast, but their diligent and persistent committee insisted upon it. He, like Sir William Larke, took the Institute seriously. He hoped the allied industries would take a pattern from their efforts to bring together the practical men, the theorists and their employers to help them over the difficult problems that confronted them. Their economic condition to-day was completely upset compared with that of pre-war times. There was an element amongst the practical men who, after their excellent efforts on the field of battle, were willing to-day to take their place in the fields of industry and bring back to our glorious old nation its traditions and status in the world. Of late years the foundry industry had made great advances in the scientific world. The foundry industry could be split into two parts—the industrial and the commercial sides. They were asked very often in the foundry world to quote a price for castings, and he must say that being asked to quote by weight was not altogether fair. Therefore, just as they had brought about research in metallurgy to perfect their practice, so they must try to inaugurate a national system of costing. Owing to scientific research and knowledge of the strength of materials, castings were made much lighter, and making them lighter increased the labour and decreased the weight. Their people must institute research, so that they could quote on an equal basis. That would be an advantage to the foundrymen and the allied industries, and give the former a better chance of existence. He coupled with the toast the name of Mr. Fox, who was their host on their last visit to the Stanton Works.

Selling Pig-Iron to Analysis.

MR. E. J. FOX (Director of the Stanton Ironworks) said, if he had been called upon to respond to the toast of the "Ladies" or "The Technical Press" he might have been able to do justice to himself, but in regard to the toast of "The Allied Industries," he found himself at a disadvantage. To what extent were they allied? He knew a little bit about manufacturing cast iron, but there was present one of the most distinguished manufacturers of glass bottles. Industries of that description passed his comprehension. One thing they had in common—the knowledge that, whilst they were passing through the difficult times which this country was in to-day, those engaged in industry had to stick together and try to support each other. He was not a member of the Institute, but he thought he was the biggest iron founder in the world, to this extent—his product was just one thing, and employed 14,000 workpeople in producing it. Mr. Slater had mentioned the question of buying pig-iron by analysis. He (Mr. Fox) made a lot of pig-iron, and he did not sell it unless he could consume it himself. That was legitimate, straightforward and genuine, but if he could not consume it in his own product, he was delighted if other folk were willing to take delivery of it. Buying by analysis was a straightforward way from the buyer's point of view, but a nuisance from the point of view of the man who was making the material, and as long as he could get rid of it without analysis, he would do so.

THE PRESIDENT said Mr. Victor Stobie happened to be his old chief, and it was with a feeling of great satisfaction that he welcomed him there to propose the toast of "The London Branch," with which his (Mr. Faulkner's) social life was so intimately associated.

MR. VICTOR STOBIE, in proposing the toast, said they had heard what Sir William Larke had said with regard to what the Londoners thought of themselves. Figure with what trepidation he approached the subject of the London Institute. However, Sir William thought the Londoners looked to the other members sometimes for a little encouragement, and he proposed to give it. That meeting gave them a good opportunity of studying them. Other technical institutes did sometimes arrogate to themselves the headquarters of an institute, but they did not find that with this Institute. They were satisfied with electing a metallurgist to their chair, and regarded the foundryman as of a better standing than they did in several of the provinces. He had known Mr. Faulkner perhaps longer than anybody in that assembly. He first met him as a metallurgical chemist in 1910, and they worked together until he came to London in 1915. He had never known a more loyal friend than Mr. Faulkner. The London Branch, in electing him their Presi-

dent, had done the best thing they could do to further their interests. He was not concerned with the commercial side of foundry work, but was out for perfecting the scientific and technical side. Mr. Faulkner had always told him that what he was after was the raising of the foundryman, as far as possible, to the status of the engineer—he meant the engineer and not the mechanic.

Metallurgy: The Common Bond of Foundry Practice.

MR. FAULKNER, in reply to the toast, said he was overwhelmed by the task of replying. First, there was the kindness of Mr. Stubbs in presenting him with a fountain pen, which was particularly welcome, as unwelcome visitors had annexed his fountain pen, amongst other goods. Then Mr. Stobie was particularly kind in his remarks. One always appreciated a testimonial from an old chief, and he much appreciated his remarks. He thanked both Mr. Stubbs and Mr. Stobie. The London Branch was not his "baby." It existed before he came to London, but when he was appointed secretary it was a "sick monkey," and it was now fairly flourishing. One of the most useful signs was the presence of Mr. J. Oswald and Mr. W. H. Aston. He hoped they would regain the old enthusiasm. The London Branch was "tarred" with metallurgy, but metallurgy was the only bond between the different classes of foundries. Some foundries did nothing else but make castings for the building trades; others made textile castings, others shipbuilding castings, and obviously they had not much in common. If a moulder who made railway chairs was asked to make a motor cylinder, he could not make much of a job of it. It might be thought that the metallurgists wanted to take the reins, but in reality they only wanted to help the foundrymen. He again thanked Mr. Stobie for the excellent way he had proposed the toast, and the company for the kind manner in which they had received it.

THE CHAIRMAN afterwards proposed the toast of "The Guests," and referred particularly to Sir William Larke, Mr. Fox, Mr. Patterson, Mr. Munday (who had lectured to them the previous night), Mr. W. G. Hollinworth (the Hon. Secretary of the Institute, who did a lot for them and could perhaps hardly be termed a guest), their old friend, Mr. J. Adamson, who accommodated them at the Institute of Marine Engineers, Mr. Walter Dixon, of Glasgow, who was expected to take interest in the Institute in the future; Mr. Norman Dewar, son-in-law of Col. Cheeswright, who was also present; Mr. W. Galbalbey, who had interested them so much in the wonderful process used in the manufacture of glass.

MR. WALTER DIXON, who replied to the toast, suggested "Take Longer Strides" as a slogan for the Institute.

The arrangements for the function were admirably carried out by Mr. H. G. Sommerfield, the honorary secretary.

An excellent variety entertainment was given during the evening, under the direction of Mr. H. Wharton-Wells, B.Mus.

Brass with Lead in It.

By Arthur W. Jordan.

Many metal workers who have read of certain advantages to be derived from a slight percentage of lead in brass required for turning, or to be lathe-finished, have tried certain recipes, only to experience considerable disappointment. There are several reasons for this, but only occasionally are they so much as suspected, the fault being generally put down to anything but the real cause.

In the first place, not every metal-mixer knows what to do with lead in the brass pot. If he has been working for years on an alloy of copper and spelter, or similar alloys, he may be all at sea when he comes to such a delicate and exacting job as properly incorporating 2 per cent. lead. Failure most frequently comes from putting in the lead too soon, and thus imperfect incorporation. In the case of the open crucible furnace, the regulation of the fire is important. After the copper is quite molten the heat may be allowed to moderate somewhat by refraining from making up the fire and letting it settle down. Then the spelter can be melted while there is plenty of heat for this purpose. Thorough incorporation of the two metals should take place before the lead is introduced. The thorough stirring may cool the pot somewhat, but after replacing the cover of the furnace this should revive the heat sufficiently to keep the contents in good condition.

If an iron poker is now put in the metal and a distinct vibration is felt, the pot is ready for withdrawal. When this has been done is the time for the lead to be added. If he is a good and careful caster in general, he will be so fearful of getting the metal too cool that while the lead may be added satisfactorily, the thorough mixing may be quite another thing, and here is disaster certain. The lead melts sufficiently quickly, but the time necessary for such a complete incorporation as is required for success frightens the man responsible for pouring, and the result is a metal that the acid test reveals to be patchy and spotty in places.

Generally, however, the careful caster is not taking any risks, and so when first starting on these lead-alloyed brasses he prefers to put the lead in before withdrawing the pot. If the necessary thorough mixing takes place, then it is likely that the lead will be all volatilised and the whole pot of metal spoilt. Again, if the pot is withdrawn and stands only a short time before pouring, the lead is apt to settle out and the resulting metal be patchy. If the lead has already burnt out, all the stirring then will not help matters. Brass needs to be poured fairly hot, so the novice does not find the getting of correct results such an easy matter as his own inexperience may have anticipated, or as the more experienced caster may have led him to believe, but proves to be both exacting and tricky.

In all alloys in which zinc enters, the manner of compounding is of the first importance. When lead is introduced a new set of factors are presented. The great difference in the specific gravities of these two metals means trouble if this point is not heeded. As soon as lead is molten its tendency is to sink to the bottom of the pot, and that of spelter is to rise to the top. This happens if the pot of metal is left for a few moments after stirring and before pouring. Hence the need for a thoroughly good stir-up before the metal is poured. Some casters will stir again half-way through the pouring, hence also in this case the need for a warm shop and entire absence of draughts—the bugbear of every good melter.

As a rule, the caster starting on lead alloys is quite careful of his weights, and where this metal is concerned in brass he cannot be too particular. Two per cent. is generally the maximum, and a very little more makes a great difference to an alloy. Some recipes give less, and where this is given as 1-41, as in the case of delta metal, 2 lb. to the hundredweight is too much, and rounding the amount in this way means spoiling the alloy, although some men are foolish enough to think it is permissible.

What is called "clock" brass has 2.5 per cent. of lead in it, the other constituents being 65 per cent. of copper and 32.5 per cent. of zinc. In this case 2½ lb. or 3 lb. to the hundredweight proves to be equally wrong. In both these alloys the weights given are those arrived at after partial research, test, and experiment, and they should be observed. The resulting alloys are used for particular and specific purposes, and if anything is put into the pot indiscriminately, it is rendered useless for these purposes. It is only in the case of bearings that greater proportions of lead are allowable; for instance, 5 per cent. for Babbitt's and 4.5 per cent. for Vaucher's metals.

The copper content of these lead alloys is apt to be overlooked, so that the bad preparation of the copper may completely neutralise the benefit for certain classes of work that the lead is to bring. Copper has the property of dissolving oxygen rapidly when in the molten state, if brought into contact with the air. This unfits it for receiving the spelter, and produces an alloy that is more trouble to work and is unsuitable for some purposes, such as those for which the lead is incorporated. In such alloys, then, it is important that the lid should be over the pot while the copper is melting and before the zinc is added.—Extract from the "Brass World."

IRON AND STEEL MARKETS.

Pig-iron.

MIDDLESBROUGH.—The market is quietly steady, notwithstanding the holiday period being at hand. Last Tuesday's market was the last to be held for three weeks, but the attendance on 'Change was, if anything, less than usual, and there was not a great deal of business doing. While the home trade has developed very satisfactorily during the closing weeks of the year, and the outlook for the New Year encourages a feeling of optimism, traders engaged in the export business are not so favourably placed. Conditions on the Continent are persistently inimical to any substantial revival of export trade, and there is nothing in recent developments which seems to point to any early escape from the existing uncertainty. Still, it is something gained that trade at home has improved, and on this basis it is possible firmly to maintain prices at recent levels. No. 1 is 107s. 6d., No. 3 G.M.B. 100s., No. 4 foundry 98s. to 99s., and No. 4 forge 97s. to 98s. per ton.

In regard to hematite, this is a strong market, though it is unsupported by any real improvement in the export demand. On the contrary, Continental makers are offering hematite to their home consumers at prices at which Cleveland cannot compete. But producers are well sold ahead, and with the current make passing steadily into consumption, there is no indication of weakness anywhere. Messrs. Pease & Partners, Limited, are putting in two furnaces on hematite at their Normanby iron works, which will bring the number of furnaces in blast on the North-East Coast to 48. This is an indication of the confidence with which the outlook in the home trade is regarded. East Coast mixed numbers are quite firm at 102s. 6d. per ton, with No. 1 at a premium of 1s. per ton.

Nothing has happened in the Cumberland and North Lancashire hematite pig-iron trade during the past few days that calls for comment. All there is to note is that forward buying for the time being is of negligible proportions, and that business of any other character is also of small extent, though it is true to say that apart from possessing fairly well-filled order books, makers are selling sufficient iron needed for immediate consumption to enable them to keep their furnaces in blast. It is inevitable that business should be on the dull side in the closing fortnight of the year, and no change can be anticipated until after the New Year.

MANCHESTER.—In this market very little is being done in foundry pig-iron this week. There are a few orders for small lots passing, and one has the impression that consumers would be willing to buy up to June, and possibly for the whole year, if sellers would contract at the current price, but sellers of pig-iron are more desirous of retaining a free hand until it is seen what sort of prices will be current at the opening of 1924. There seems to be quite a strong belief that the makers of Cleveland iron will put up their price for No. 3 to 105s. early next month, and the Derbyshire makers think that this will justify some further advance in Midland pig-iron. Hence they are not desirous of selling more iron at 95s. except for immediate delivery. One or two Derbyshire makers are now asking 96s. and 96s. 6d. per ton at the furnaces, but the more general price is 95s. for Derbyshire No. 3 and 92s. 6d. for Northamptonshire on trucks. One has not yet heard that the North Lincolnshire furnaces are to be started again, but this may perhaps be expected early in the New Year, and, if so, any serious advance in the Manchester price may be checked for a time, but the present prices for pig-iron in the Midlands do not leave any very large margin of profit for the producer. Scotch pig-iron is firmer here, and the market generally in Scotland is stronger than in other districts. Possibly some Scotch iron could be bought here still at 125s. delivered, but the tendency is now to ask 127s. 6d. delivered, so that the Midland irons might advance by 5s. and still maintain the same relation to Scotch.

THE MIDLANDS.—The increases notified last week were firmly maintained, and producers were very cautious. Of course there was not much new demand in view of the approaching holiday, and of the further fact that most buyers are now fairly well covered for some time ahead. Naturally the higher quotations chiefly affect prompt business because it is extremely doubtful whether consumers are yet prepared to buy beyond the end of this present contract. There are works who covered their requests to the end of February on the basis of 82s. 6d. at furnaces for Northamptonshire forge, and these hesitate to buy farther forward at a minimum of 88s. Of course there is always the possibility that they may have to pay more the longer they delay, but some of them seem prepared to risk that; at any rate until the New Year. Probably they are also hoping that, as is usually the case, the holiday interruption will lead to some accumulation of iron at the furnaces, and that they may be able to buy for prompt delivery to get the advantage as soon as the year is turned. Quotations: Northamptonshire forge, 88s.; No. 3 foundry, 93s. 6d.; Derbyshire forge, 90s.; No. 3 foundry, 95s., all net f.o.t. furnaces.

SCOTLAND.—The quietness which was notified in the Scotch pig-iron market last week continues, and it is generally anticipated that there will be no change in the conditions until after the holidays. Meantime, makers' prices remain firm at £5 7s. 6d. for No. 3 foundry at furnaces, but very little business has been put through this week. The engineering founders are not feeling any great improvement in the demand, and in consequence are only buying very moderately. There have been some good orders placed this week by the railway companies for chairs and accessories, and it is understood that delivery extends right up to the end of next year. Prices of Middlesbrough iron are unchanged at £5 7s. for No. 3, and £5 5s. for No. 4 foundry, f.o.t. Grahamston. There is practically no business passing in No. 4 forge, the quotation for which is £5 6s., f.o.t., Coatbridge, but No. 4 Scotch could be got at a shade less. Continental iron is being offered a little more freely, and is quoted at £5 for No. 3 foundry at Grahamston. However, consumers are pretty well bought for the next few months and very few sales are being made. The demand from abroad shows no improvement. Hematite continues to be very firm, and consumers are still anxious to cover for forward delivery, but makers are not at all keen to sell, and the quotation for M/nos. Scotch hematite is held at £5 10s. delivered. With Continental basic obtainable at about 10s. per ton less, the tendency will be to buy the latter, and some good parcels have been closed for delivery over the next few months.

Finished Iron.

The finished iron market was almost stagnant as far as new business was concerned, but operations in the works were carried on actively until the last minute. Fortunately order books bear a much healthier appearance than they did a few weeks ago, and there will be a prompt resumption as soon as holidays and stocktaking are over. Naturally this conduced to very firm quotations, although there was so little demand. Another influence in the same direction was the higher price and firmness of pig iron. At the prices now ruling for this raw material finished iron manufacturers cannot afford to cut their own prices, which are none too profitable, notwithstanding the recent improvement. Quotations: Marked bars, £14 10s. (net f.o.t. makers' works); crown bars, £12 10s.; second grade, £12; nut and bolt bars, £11; gas strip, £12 10s.; all net delivered Birmingham.

Steel.

The quantity of work now on the books is making steel prices extremely firm. It is reported that some firms are beginning to ask £9 for soft billets, but for the time being at any rate that figure is well above the market, in view of the fact that similar material is still to be had at less than £8 15s. Of course the Welsh works are very well sold, and all their output is going immediately into consumption, but the remarks made concerning pig-iron apply equally to steel—it would be comparatively easy to choke off trade if prices are advanced too rapidly and too high. There has been a fairly considerable advance in billet prices already and it has to be remembered that world conditions are not such as to warrant unrestricted appreciation. The sectional branch of the industry is filling up quietly and conditions are much more promising than they were. The only exception to the general conditions is furnished by galvanised sheets, which, notwithstanding the recent reports as to the extent of the forward booking, are rather weaker in some quarters, quotations of £18 15s. being reported.

Scrap.

Generally speaking, the scrap market has for the time being become a little slow chiefly due to the presence of the holidays and the end of the half-year. Most of the steel works have secured fair quantities, and are inclined to keep off the market until next year. Some of the works have received such large quantities that suppliers have been asked to ease off their deliveries. Suppliers are not offering material freely and are still firm in their prices. Heavy steel scrap in furnace sizes is quoted at 100s. to 105s., while works ideas are from 95s. to 97s. 6d.

Bundled steel scrap and shearings have a steady demand at 85s. to 100s., according to origin and methods adopted in bundling. Steel turnings are quiet but firm at 87s. 6d. to 90s. Mixed wrought iron and steel scrap for basic furnaces is not so active. Good heavy, however, remains firm at 92s. 6d. Light, suitable for bundling, is quieter at 50s. to 55s. Heavy cast-iron scrap in large pieces, but in furnace sizes, continues to have a steady demand at 90s. to 95s. Good machinery scrap for foundry purposes has a quiet market at 92s. 6d. and upwards.

Metals.

Copper.—There is practically no change in the general position, nor is there any very decided tendency, values having remained almost stationary throughout the week. In America producers have sold fair quantities, and show no keenness to cut prices. Second hands, however, have liquidated small lines at lower figures. American consumers have bought considerable quantities of metal recently, and have profited by the large production to do this steadily, and so avoid a rapid advance in values. The American copper situation is largely dominated by the big and cheap production in South America, and all consumers appear to have the course of the market at the present time largely in their own hands. Consumption in this country remains steady, but the German situation is the most interesting at the moment as offering the most likely source of an increase in consumption.

Current quotations:—*Cash*: Thursday, £61 15s.; Friday, £61 10s. *Three Months*: Thursday, £62 12s. 6d.; Friday, £62 5s.

Tin.—There was some very pronounced liquidation on speculative account at the opening of the week, and prices have receded somewhat from their recent high level. It remains to be seen whether a retrograde movement will set in with the New Year, but prominent operators are confident that prices will be held around present levels, and in some cases even anticipate a further rise. America has bought largely, and Continental demand has been satisfactory. South Wales continues busy, and the demand for tin is quite good, with a disposition to buy for forward delivery.

Current quotations:—*Cash*: Thursday, £230 10s.; Friday, £235. *Three Months*: Thursday, £232 10s.; Friday, £236 12s. 6d.

Spelter.—This market has ruled steady, fluctuations having been confined within narrow limits. As is indicated by the steadiness of the market, the position has undergone no marked change, the attitude adopted by producers and consumers alike being apathetic, due no doubt to the approaching turn of the year, but consumption meanwhile is satisfactorily maintained.

Current quotations: — *Ordinary*: Thursday, £32 13s. 9d.; Friday, £32 12s. 6d.

Lead.—Firm conditions have prevailed, and on the whole the market is fairly active. Demand on the part of consumers may perhaps have been a little less urgent, due to a seasonal falling-off in inquiry for manufactured material, but consumption remains good.

Current quotations:—*Soft foreign (prompt)*: Thursday, £30 10s.; Friday, £30 12s. 6d.

Company News.

Howard & Bullough, Limited.—Quarterly dividend, 6d. per share, less tax.

Parkinson and W. & B. Cowan, Limited.—Interim dividend, 6d. per share on ordinary, less tax.

Ebbw Vale Steel, Iron and Coal Company, Limited.—Interim dividend on preference shares will not be paid.

L. Gardner & Sons, Limited.—Dividend on 7 per cent. preference shares deferred until third week in January.

Pryce, Limited, Corbichall, Bo'ness.—Capital £1,000 Electrical engineers, etc. Directors: W. H. Boyd and J. G. Pryce.

Nash Engineering Company, Limited, 184, Stockport Road, Manchester.—Capital £2,000. Directors: G. M. Nash and E. Tredwell.

David Fleming, Limited, 39A, Renfield Street, Glasgow.—Capital £6,000. Die makers. Directors: D., Mrs. H., and Miss G. Fleming.

J. Starkie Gardner, Limited, 9-10, King Street, London, E.C.—Capital £3,000. Metal workers, etc. Directors: A. S. Gardner and C. Brannan.

Bell's (Yorks), Limited, 5, Upperhead Row, Leeds.—Capital £100. Manufacturers of and dealers in dynamos, electric motors, etc. Director: M. Myers.

H. R. Morgan, Limited, 40, Chancery Lane, London, W.C.—Capital £4,000 in 3,997 £1 ordinary and 60 1s. deferred. Tinplates and metal merchants, etc.

Longhill Foundry, Limited, West Hartlepool.—Capital £6,000 in £1 shares. Directors: W. H. Laveridge and F. B. Magee. Secretary: A. McLellan.

Bridgwater Wire Rope Works, Limited, Monmouth Street, Bridgwater, Somerset.—Capital £1,000. Permanent directors: W. H. Berryman, P. V. Hellard and H. Ford.

High Salvington Electric Supply Company, Limited, 21, Chapel Road, Worthing.—Capital £1,300. Directors: F. R. Cripps, Dr. H. J. M. Milbank and V. H. Poynter.

Hydraulic Power & Manufacturing Company, Limited.—Capital £4,000 in 1s. shares. Solicitors: Holmes, Son & Pott, Capel House, New Broad Street, London, E.C.

Stanley Smith & Company (Wire), Limited, Louisa Street, Parade, Birmingham.—Capital £7,000 in £1 shares (2,000 6 per cent. cumulative preference and 5,000 ordinary).

Ransome & Marles Bearing Company, Limited.—Depreciation, £14,609; profit, £27,485; debit balance brought forward, £16,645; credit balance, £10,840, carried forward.

Carlton Wagon Company, Limited, Union & Smiths Bank Chambers, Hull.—Capital £6,000 in £1 shares (1,000 preferred ordinary and 4,300 deferred ordinary). Director: W. Hargreaves.

Star Architectural Ironworks, Limited, 613½, Gallowgate, Glasgow.—Capital £5,000 in £1 shares (2,000 preference and 3,000 ordinary). Directors: Mrs. A. Collins and C. D. Mathieson.

Casey, Bean & Cassells, Limited, Heshbon Works, Dudley Hill, Bradford.—Capital £5,000. Engineers and patentees of lubricating rings and centrifugal clutches. Directors: A. Smith (permanent) and W. A. Heaton.

Cleveland Bridge and Engineering Company, Limited.—Gross profit, £47,356; net profit, £40,395; brought forward, £10,563; further ordinary dividend, 7½ per cent., free of tax, making 10 per cent., tax free, for year; reserve, £10,000; carried forward, £8,450.

James Dowling & Company (Engineers), Limited.—Capital £7,050 in 2,000 7 per cent. cumulative preference and 5,000 ordinary shares of £1 and 1,000 "E" shares of 1s. each. Directors: H. Kipling, E. S. Megson (of 35, Jewin Street, London, E.C.), F. Sheldon, F. Haverson, and E. E. Kipling.

Gwynedd Trust, Limited, Wellington House, Buckingham Gate, London, S.W.—Capital £10,000 in 9,500 £1 7 per cent. cumulative preference and 10,000 1s. ordinary. Hydro-electric, electric, hydraulic and other power supply company. Directors: H. J. Jack, E. H. F. Reeves, D. Spencer and E. R. Davies.

Marcroft & Company, Limited.—Capital £25,000 in £1 shares, to acquire the business of E. Marcroft & Company, wagon builders, repairers and merchants, carried on at Swansea, Radstock, Port Talbot, and elsewhere. Directors: E. Marcroft and H. C. Marcroft. Solicitor: C. W. Slater, 18, York Place, Swansea.

Vickers & International Combustion Engineering, Limited.—Capital £500,000 in £1 shares (300,000 "A" and 200,000 "B"). Directors: Sir Trevor Dawson, Bart. (vice-chairman and managing director of Vickers, Limited), G. R. T. Taylor, G. E. Learnard and W. R. Wood (chairman, International Combustion Engineering Company, Limited). Solicitors: Maswell, Scriven & Batley, 29, Great St. Helen's, London, E.C.

Baldwins, Limited.—Profits, £484,759; depreciation, £70,000; sinking fund premiums for redemption of leaseholds and 4½ per cent. debenture stock, £11,357; debenture stock interest, £191,250; reserve for redemption of 7½ per cent. debenture stock for half-year to June 30, £11,250; dividend on 5½ per cent. preference shares, £13,750; dividend on 5 per cent. (free of tax) "B" preference shares, £72,190; brought forward, £309,178; carried forward, £424,140; no ordinary dividend.

Gazette.

A RECEIVING ORDER has been made in connection with the affairs of Mr. T. Hodgson, trading as F. Hodgson & Son, metal merchants, Wharfe Street, Shipley.

THE LAST DAY for receiving proofs in connection with a dividend to be paid by Mr. T. Whittaker and Mr. T. H. Whittaker, trading as Thos. Whittaker & Sons, Canal Foundry, Church, near Accrington, is December 31.

MESSRS. H. NEVILLE, W. D. Joyce and A. J. Singlehurst, electrical engineers, 54, Berry Street, Liverpool, trading under the style of the Cogent Electrical Company, have dissolved partnership. Mr. A. J. Singlehurst continues.

Personal.

MR. J. H. HEWSON has been elected a director of Richard Melhuish, Limited, 50, Fetter Lane, London, E.C.4.

MR. F. J. MASON, lately secretary of Robert Heath and Low Moor, Limited, has been the recipient of a presentation from the officials and men.

MR. W. J. BERRY, Director of Warship Production, is to succeed Sir Eustace Tennyson d'Eyncourt as head of the constructive branch at the Admiralty.

MR. HARRY SMITH, the managing director, to mark his completion of 50 years' service with the firm of Abbots' Foundry Company, Limited, Falkirk, has been made the recipient of a handsome presentation from the employés.

MR. JOSEPH MACGREGOR, of Smith's Dock Company, Limited, North Shields, has been appointed general manager of the ship repairing department of the Palmer Shipbuilding and Iron Company, Limited, Jarrow and Hebburn.

MR. S. EVANS, for several years traffic manager at the Blaenavon Company's works and collieries, is leaving the district to take up a similar appointment at the Mellingriffith Works, near Cardiff. His successor at Blaenavon is Mr. Rees Jones.

SIR VINCENT L. RAVEN will retire at the end of the year from the position of technical adviser to the London and North-Eastern Railway Company. Sir Vincent Raven is a director of the Metropolitan-Vickers Electrical Company, Limited.

Wills.

BAYLES, W. G. S., a director of George Blackburn & Sons, Limited	£17,407
CRAWLEY, E. W., of Acorn Villa, Ilkley, Yorks, iron and metal merchant	£12,256
HORSFIELD, J. H. H., secretary of the Scottish Wagon Company, Limited.....	£20,685
TYZACK, F., of Psalter House, Brincliffe, Sheffield, of W. Tyzack, Sons & Turners, Limited	£22,114
HOBSON, SIR ALBERT J., chairman of William Jessop & Sons, Limited, Thomas Turner & Company (Sheffield), Limited, J. J. Saville & Company, Limited, and vice-chairman of High-Speed Steel Alloys, Limited	£139,660

Obituary.

MR. J. W. EASON, partner in the Wynnfield Iron Company, of Grimsby, died recently in his 55th year.

MR. J. MITCHELL, chairman of Theo. Phillips, Son & Company, Limited, of Middlesbrough, died last week.

PROFESSOR FRANK CLOWES, the eminent chemist and gas expert, died last week at his residence in Dulwich, aged 75.

MR. N. KILBURN, J.P., chairman of Lingford, Gardiner & Company, Limited, locomotive engineers, ironfounders, etc., of Bishop Auckland, died on December 4, aged 80 years.

MR. D. BOWIE, former works' engineer at the Derwent Works at Workington, died at Cockermouth recently. The deceased, who was 70 years of age, went to Cumberland from Lanarkshire forty years ago. He was the first man at the Distington Ironworks, the erection of which he superintended. Later he went to the Derwent Works at Workington, and remained there for over thirty-six years. He retired about eight years ago. His eldest son, Mr. Lachlan Bowie, is manager of the Derwent blast-furnaces at Workington.

MR. P. J. MARSHALL, eldest surviving son of the late Mr. Henry Marshall, of the firm of Marshall, Sons & Company, Limited, died suddenly last week, at his residence, Knaith Hall. Mr. Marshall's health lately appeared to have much improved as he was able to take some part in the election, and on the day of his death he motored into Gainsborough and returned home apparently quite well. He retired several years ago from active connection with the Britannia Ironworks—he had control of the Trent Works section—but he continued to reside in the locality.

Fellowship of the British Empire Exhibition.—A new Fellowship has been instituted in connection with next year's British Empire Exhibition. H.R.H. the Prince of Wales has accepted the Presidency of the Fellowship. Further particulars may be obtained from the Secretary, 16, Grosvenor Gardens, London, S.W.1.

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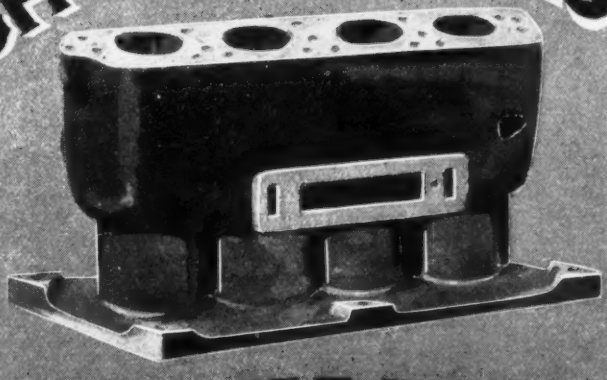

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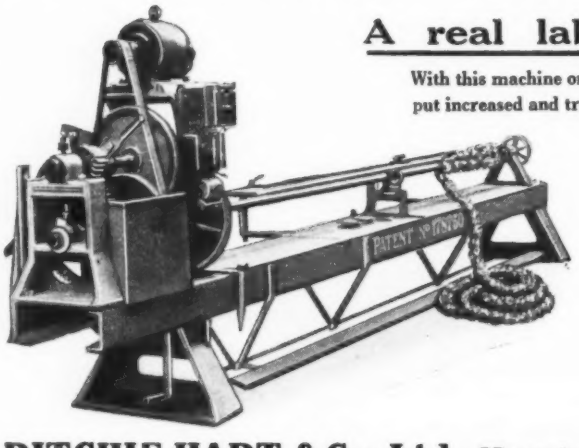

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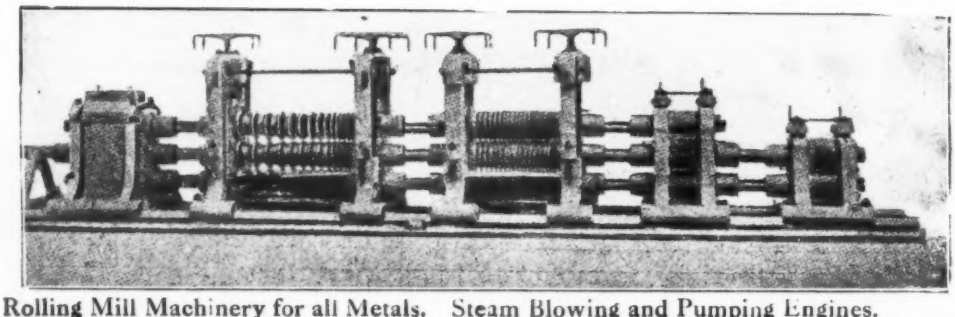

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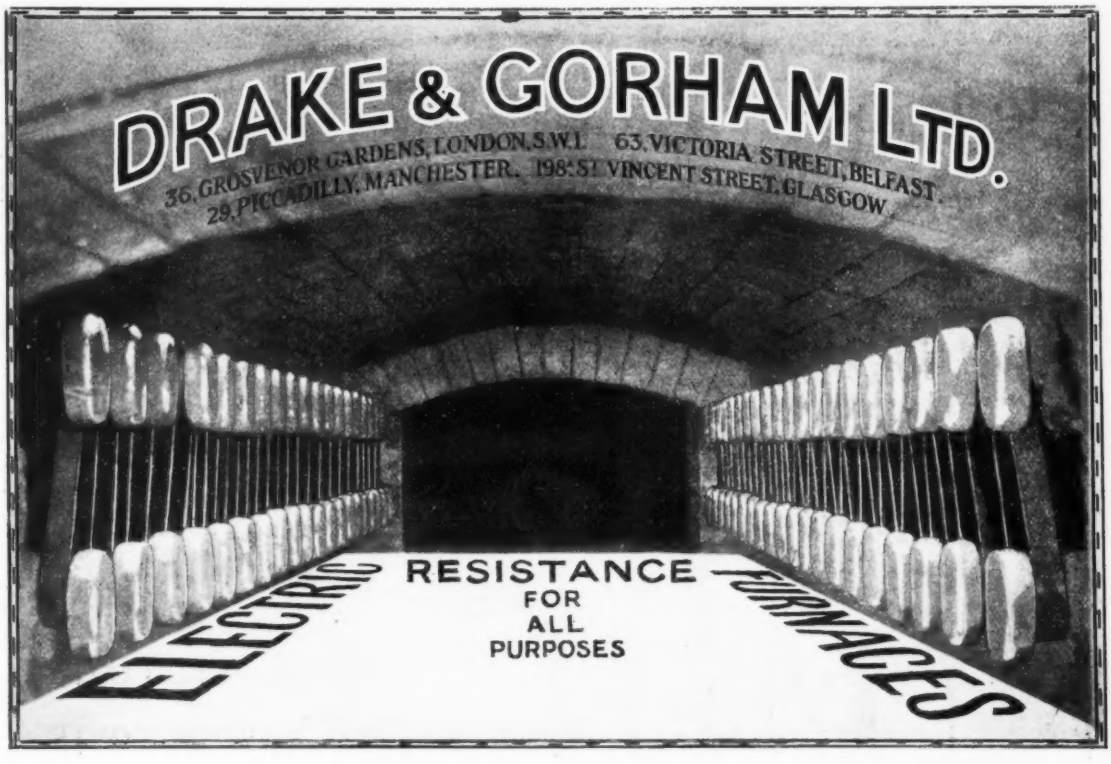
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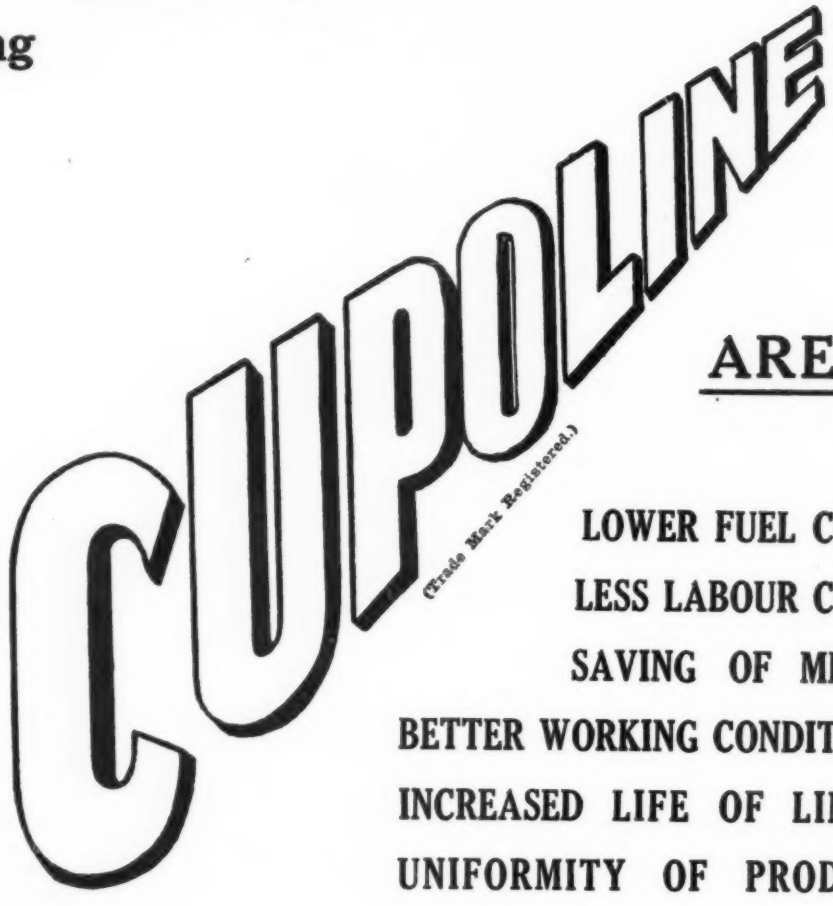

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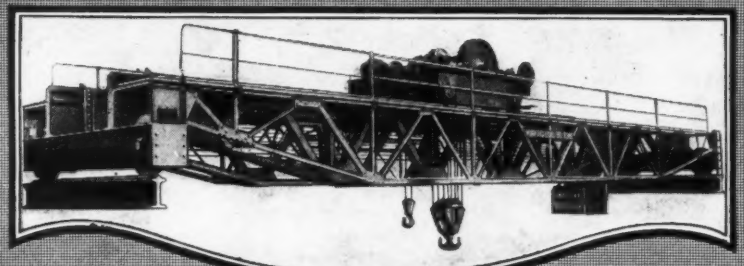

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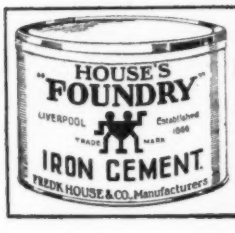

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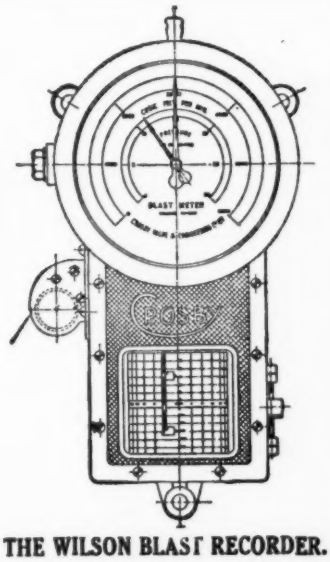

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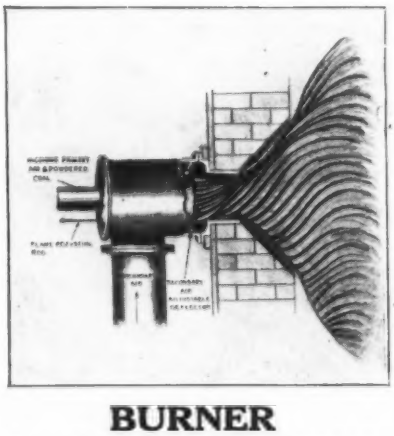

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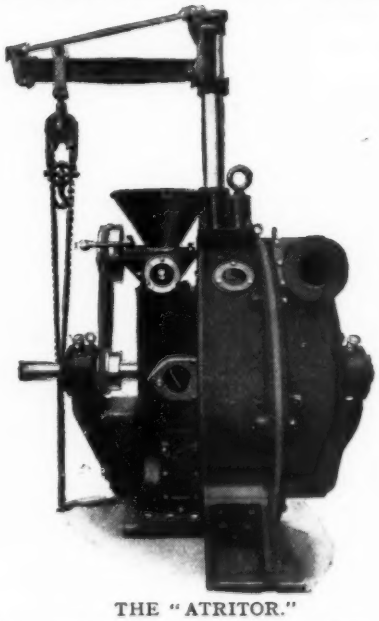

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Necol Industrial Collodions, Ltd.	25
New Eagle Foundry Co., Ltd.	—
Notcutt, W. P. Ltd.	—
Olsen, Wm. Ltd.,	—
Parish, J., & Co.	12
Parkgate Iron & Steel Co., Ltd.	—
Penman & Co.	—
Perry, Thos., & Son, Ltd.	6
Phillips, J. W., & C. J.	—
Pickard, W., & Co.	—
Pickford, Holland & Co., Ltd.	19
Portway, C., & Son	—
Potter, Cowan, & Co.	—
Priestman, T. J.	14
Prior, S. J. Burrell, Ltd.	23
Purden, Chas., Ltd.	—
Ransome Machinery Co. (1920) Ltd.	—
Ritchie, J. & R., Ltd.	14
Ritchie Hart & Co., Ltd.	6
Roberts, Glazebrook & Co., Ltd.	25
Roberts, Wm., & Son	24
Robson Refractories, Ltd.	8
Roper, E. & Co.	19
Ross, J., & Co. (Lime Wharf), Ltd.	4
Ryarsh Sand Co.	12
Sankey, J., & Sons, Ltd.	—
Sankey, J. H., & Son, Ltd.	—
Shore, Douglas W.	—
Shotts Iron Co., The	—
Shropshire Iron Co. Ltd.	19
Simm, Martha, & Son	23
Smart, H. & H. E.	24
Smith, Albert, & Co.	—
Smith, Edward, Ltd.	1
Smith, F., & Co. (Wire Mfs.), Ltd.	—
Smith, Thos., & Sons (Rodley), Ltd.	9
Smooth-on Mfg. Co.	—
Spermolin, Ltd.	11
Standard Sand Co., Ltd.	1
Staveley Coal & Iron Co. Ltd.	—
Steel Co. of Scotland, Ltd.	28
Stella Gill Coke & By-Products Co., Ltd.	—
Stephens & Co.	26
Sterling Foundry Specialties, Ltd.	—
Stevenson, J., Ltd.	24
Stewart, Duncan, & Co., Ltd	—
Stewarts & Lloyds, Ltd.	28
Tallis, E.	—
Tanks & Drums, Ld.	13
Taylor & Farley, Ltd.	25
Tennent, R. B., Ltd.	20
Terry, John M., & Co.	—
Thermit, Ltd.	2
Thomas, G. & R.	—
Thwaites Bros., Ltd.	—
Townley, E., & Sons	—
Turner, J., & Son	—
Universal System of Machine Moulding & Machinery Co., Ltd.	—
Utard A. Etablissements	—
Wadkin & Co.	—
Wailes Dove Bitumastic, Ld.	—
Walker, I. & I.	22
Wallwork, Hy., & Co.	—
Ward, Thos, W., Ltd.	18
Waring Bros.	12
Watson's (Metallurgists) Ltd.	25
Wellman Smith Owen Eng'g Corporation, Ltd.	12
West Midland Refining Co.	—
Westoby & Rawstron	3
Whittaker, W., & Sons	—
Whittingham, W. M., & Co.	22
Wilkinson, Thos., & Co., Ltd.	14
Williams, John (Birmingham Sand), Ltd.	24
Woodward Bros. & Copelin, Ltd.	24
Yorkshire Amalgamated Products, Ltd.	12

THE PRE-EMINENT HOUSE FOR

ALUMINIUM

"CRANK CASE" & "PISTON ALLOYS"

IN NOTCHED BARS FOR SAND AND DIE CASTING.

The Brand the ALUMINIUM AND COPPER ALLOYS TPJ *that means Best*

STEEL MAKERS' ALUMINIUM STICKS ALSO SPECIFICATION.

BRASS AND GUNMETAL INGOTS

T. J. PRIESTMAN "Cupro" Foundry LEOPOLD STREET **BIRMINGHAM**

Telephone (Private Exchange Branch): MIDLAND 281. Telegrams. "SPECIFIC, BIRMINGHAM."

BLACKINGS
PLUMBAGO
COAL DUST
CHAPLETS
NAILS and SPRIGS
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STRAW ROPE
&c., &c.

"Carlton" Patent Blacking

AGENTS FOR
"GLUTRIN"

THOMAS WILKINSON & CO., LTD., MIDDLESBROUGH.

BUTTERWORTH - BROS., Ltd.,

MANUFACTURERS OF
"TENAX" & "BULL-DOG"
GAUGE GLASSES
(Enamelled and Plain)
For Highest Pressure
LUBRICATORS
AND ALL KINDS OF
MACHINERY GLASS,

Newton Heath Glass Works,
MANCHESTER.

CAST IRON FLANGED

PIPES

2 in. to 12 in. Bore.

THOMAS ALLAN & SONS, Ltd.,
Bonlea Foundry, Thornaby-on-Tees.

James & Ronald Ritchie, LTD.

Acklam Foundry, Middlesbro'.

Manufacturers of
Cast Iron Pipes and Fittings
of every description.
Telegrams:
"RITCHIE, MIDDLESBROUGH."

ARMSTRONG-WHITWORTH

SHIPS
MARINE ENGINES
LOCOMOTIVES
MACHINE TOOLS
FORGINGS CASTINGS
NON-FERROUS PRODUCTS
DROP STAMPINGS
HIGH SPEED STEELS
SMALL TOOLS GAUGES
PNEUMATIC TOOLS
ELECTRIC LIGHTING SETS
ROAD MAKING MACHINERY
HYDRAULIC MACHINERY
HYDRO-ELECTRIC PLANT
CIVIL ENGINEERING
GENERAL ENGINEERING

SPECIAL PIG IRONS OF GUARANTEED ANALYSIS & PHYSICAL PROPERTIES.

A.W. Special Pig Irons comprise a series of high grade irons of guaranteed analysis and physical properties.

The following are some of the advantages to be gained by their use.

1. GUARANTEED CHEMICAL COMPOSITION.
2. CONSISTENT QUALITY.
3. ASSURED PHYSICAL TESTS, INCLUDING TENSILE, TRANSVERSE, WEAR & HYDRAULIC.
4. INCREASED LIFE OF CUPOLA LINING, REDUCTION IN FLUX & COKE REQUIRED DUE TO SMALL SIZE & CLEAN SMOOTH SKIN OF PIGS.
5. REMARKABLY FINE TEXTURE ENSURING TOUGH, CLOSE GRAINED EASILY MACHINED CASTINGS.

A.W. Special Pig Irons are in use for a wide variety of the highest grade castings.

We shall be pleased to send a representative to discuss your requirements and to advise you as to the best mixture for your purpose.

Kindly enclose this page and your business card or letterhead with your enquiry.

SIR W.G. ARMSTRONG, WHITWORTH & Co. Ltd.
WORKS - - - OPENSHAW and GATESHEAD.

London Office: 8, Great George Street, Westminster, S.W.1.

Telephone: *Victoria 4010 (6 lines).* *Code:* *Bentley's* *Telegrams:* *Zigzag, Parl, London.*

British Empire Exhibition, Wembley, 1924.

WEEKLY PRICE CURRENT.

COPPER.

	£	s.	d
Standard cash	61	10	0
Three months	62	5	0
Electrolytic	67	15	0
Tough	65	15	0
Best selected	65	15	0
Sheets	95	0	0
India	83	0	0
Wire bars	68	0	0
Do. January	68	0	0
Do. February	68	0	0
Ingot bars	67	15	0
H.C. wire rods	73	0	0
Off. av., cash, Nov. 61	14	2	5/8
Do. 3 mths., Nov. 62	6	9	3/8
Do. Settlement, Nov 61	13	9	
Do. Electro, Nov. 66	16	3	
Do. B.S., Nov. 65	4	2	
Aver. spot price, copper, Nov.	61	13	3½
Do. Electro, Nov. 67	2	11½	

Solid drawn tubes 13½d.
Brazed tubes 13½d.
Wire 10d.
Yellow metal rods 7½d.
Do. 4x4 Squares 8¾d.
Do. 4x3 Sheets 9¾d.

BRASS.

Solid drawn tubes 12d.
Brazed tubes 13½d.
Rods, drawn 10⅞d.
Rods, extruded or rolled 7½d.
Sheets to 10 w.g. 10½d.
Wire 10½d.
Rolled metal 9¾d.

TIN.

	£	s.	d
Standard cash	235	0	0
Three months	236	12	6
English	236	0	0
Bars	238	0	0
Chinese			—
Straits	237	0	0
Australian	236	10	0
Eastern	235	0	0
Banca	238	5	0
Off. aver., cash, Nov.	220	16	5½
Do. 3 mths., Nov.	220	15	4½
Do Sttlment, Nov	220	15	0
Aver., spot, Nov.	220	14	2½

SPELTER.

	£	s.	d
Ordinary	32	12	6
Remelted	29	10	0
Hard	27	0	0
Electro 99.9	36	10	0
English	32	17	6
India	28	15	0
Prime Western	32	17	6
Zinc dust	45	0	0
Zinc ashes	11	10	0
Off. aver., Nov.	33	0	1½
Aver., spot, Nov.	32	18	9½

LEAD.

	£	s.	d
Soft foreign ppt	30	12	6
English	32	5	0
Off. average, Nov. 29	3	10	5/8
Average, spot, Nov 30	7	0	½

ZINC SHEETS, &c.

	£	s.	d
Zinc sheets, English	38	10	0
Do. V.M. ex whf.	38	0	0
Dutch	36	15	0
Reds	45	0	0
Boiler plates	37	0	0
Battery plates	37	10	0

ANTIMONY.

	£	s.	d
English regulus			—
Special brands	44	0	0
Chinese	36	0	0
Crude	24	0	0

QUICKSILVER.

	£	s.	d
Quicksilver	9	12	6

FERRO-ALLOYS AND STEEL-MAKING METALS.

Ferro-silicon—
45/50% £11 10 0
75% £19 0 0
Ferro-vanadium—
35/40% 19/6 lb. va.
Ferro-molybdenum—
70/75% c. free 8/9 lb.
Ferro-titanium—
23/25%, carbonless 1/2 lb.
Ferro-phosphorus, 20/25%, £35 0
Ferro-tungsten—
80/85% c. free 1/4½–1/5½ lb.
Tungsten metal powder—
98/99% 1/9½ to 1/10 lb.
Ferro-chrome—
4/6% car. £23 10 0
6/8% car. £23 0 0
8/10% car. £22 10 0
Ferro-chrome—
Max. 2% car £47 0
Max. 1% car. £56 0
Max. 0.70% car. £68 0
67/70%, carbonless 1/5½ lb.
Nickel—99%, cubes or pellets £128 to £135
Cobalt metal—98/99% 11/–lb
Aluminium 98/99% £115
Metallic Chromium—
96/98% 4/3 lb.
Ferro-manganese (net)—
76/80%, loose £17 0
76/80%, packed £18 0
76/80%, export £17 0
Metallic manganese—
94/96%, carbonless 2/– lb.
Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL.

Finished bars, 14% s. d. tungsten 2 6
Finished bars, 18% tungsten 3 0
Per lb. net, d/d buyers' works.

Extras—
Rounds and squares 3 in. to 8 in. inclusive 4d. lb.
Rounds and squares under ½ in. to ¼ in. 3d. lb.
Flats under 1 in. by ⅛ in. to ½ in. by ¼ in., and all sizes over four times in width over thickness 3d. lb.
Bevels of approved sizes and sections 6d. lb.
If in coils 3d. lb.
Bars cut to length 10% extra

Scrap from high-speed tool steel—
Scrap pieces 3d.
Turnings and swarf 1d.
Per lb. net, d/d steel makers' works.

SCRAP.

	£	s.	d
South Wales—			
Heavy steel	5	2	6
Bundled steel & shrngs.	4 5 0	5	0
Mixed iron & steel	4 12 6	4	15 0
Heavy cast iron	4 10 0	4	15 0
Good machinery for foundries	4	12	6
Cleveland—			
Heavy steel	4	15	0
Steel turnings	3	10	0
Cast-iron borings	3	10	0
Heavy forge	5	15	0
Bushelled scrap	4	17	6
Cast-iron scrap	4	11	0
Lancashire—			
Cast-iron scrap	4	11	3
Heavy wrought	4	16	3
Steel turnings	3	12	6
London — Merchants' buying prices delivered yard.			
Copper (clean)	56	0	0
Brass (clean)	36	0	0
Lead (less usual draft)	28	10	0
Tea lead	26	10	0
Zinc	23	0	0
New aluminium cuttings	90	0	0
Braziery copper	47	0	0
Gunmetal	44	0	0
Hollow pewter	160	0	0
Shaped black pewter	100	0	0

PIG-IRON.

N. E. Coast—
Foundry No. 1 107/6
Foundry No. 3 100/–
Forge No. 4 97/6
Mottled 97/6
Hematite No. 1 103/6
Hematite M/Nos 102/6
N.W. Coast—
Hem. M/Nos. d/d Glas. 115/–
„ „ d/d Birm. 120/–
Midlands—
Staffs. common* 101/3
„ No. 4 forge* 97/–
„ No. 3 foundry* 107/6
„ Cold blast, ord. 190/–
„ „ roll iron 200/–
„ basic 102/6
* d/d Birmingham district.
Northants forge 88/–
„ fdry. No 3 93/6
Derbyshire forge 90/–
„ fdry. No. 3 95/–
„ basic 97/6
Scotland—
Foundry No. 1 112/6
„ No. 3 107/6
Hematite M/Nos. 110/–
Sheffield (d/d district)—
Derby forge 94/–
„ fdry No. 3 99/–
Lincs. forge 95/9
„ foundry No. 3 98/9
E.C. hematite 111/6
W.C. hematite 115/–
Lincs. (at furnaces)—
Forge No. 4 94/–
Foundry No. 3 95/6
Basic 95/–
Lancashire (d/d eq. Man.) —
Derby forge 94/–
„ foundry No. 3 103/–
Northants foundry No. 3 105/–
Dalzell, No. 3 124/6
Summerlee, No. 3 124/6
Glengarnock, No. 3 124/6
Gartsherrie, No. 3 124/6
Monkland, No. 3 124/6
Coltness, No. 3 124/6
Shotts, No. 3 124/6

FINISHED IRON & STEEL.

Usual District deliveries for iron; delivered consumers' station for steel.

Iron—	£	s.	d
Bars (cr.)	12 0 0 to 12	10	0
Angles	12 5 0 to 12	15	0
Tees to 3 united ins.	13 0 0 to 13	10	0
Nut and bolt	11	0	0
Hoops	£14/10 to 15	0	0
Marked bars (Staffs.)	14	10	0
Gas strip	12	10	0
Bolts and nuts, ⅜ in. × 4 in.	19	0	0
Steel—			
Ship plates	£10 5/– to 10	10	0
Boiler plates	13	10	0
Chequer plates	11	5	0
Angles	10	0	0
Tees	11	0	0
Channels	9	15	0
Joists	10	0	0
Rounds & squares 3 in. to 5½ in.	11	5	0
Rounds under 3 in. to ⅜ in.	11	0	0
Flats, over 5 in. wide and up	11	10	0
Flats, 5 in. to 1½ in.	10	15	0
Rails, hvy	£9 0 0 to 9	10	0
Fishplates	13	0	0
Hoops (Staffs.)	12	5	0
Black sheets, 24 g.	14	0	0
Galv. cor. sheets, 24 g.	18	17	6
Galv. fencing wire. 8 g. plain	18	5	0
Rivets, ½ in. dia.	13	0	0
Billets, soft	£8/5 to 8	15	0
Billets, hard	£10 to 10	5	0
Sheet bars	£8/10 to 8	15	0
Tin bars d/d (less rebate 7/6)	8	18	9

PHOSPHOR BRONZE.

	Per lb.	basis.
Strip	1	2¾
Sheet	1	3¼
Wire	1	3¾
Rods	1	2½
Tubes	1	5¼
Castings	1	1

Delivery 3 cwt. free.
10% phos. cop. £40 above B.S.
15% phos. cop. £50 above B.S.
Phosphor tin (5%), £30 above price of English ingots.
C. CLIFFORD & SON, LIMITED

NICKEL SILVER, &c.

	Per lb.
Ingots for raising	9d. to 1/3
Rolled—	
To 9 in. wide	1/3 to 1/9
To 12 in. wide	1/3½ to 1/9½
To 15 in. wide	1/4 to 1/10
To 18 in. wide	1/4½ to 1/10½
To 21 in. wide	1/5½ to 1/11½
To 25 in. wide	1/6½ to 2/0½
Ingots for spoons and forks	9d. to 1/3
Ingots rolled to spoon size	1/– to 1/6
Wire round—	
3/0 to 10 G.	1/6½ to 2/1½

with extras according to gauge

AMERICAN IRON & STEEL.

At Pittsburgh unless otherwise stated.

	Dols.
No. 2X foundry, Phila.	24.26
No. 2 foundry, Valley	22.00
No. 2 foundry, Birm.	21.00
Basic	22.77
Bessemer	24.26
Malleable	21.77
Grey forge	23.26
Ferro-mang. 80% d/d	107.50
Bess. rails, h'y, at mill	43.00
O.-h. rails, h'y, at mill	43.00
Bess. billets	40.00
O.-h. billets	40.00
O.-h. sheet bars	42.50
Wire rods	51.00

	Cents.
Iron bars, Phila.	2.67
Steel bars	2.40
Tank plates	2.50
Beams, etc.	2.50
Skelp, grooved steel	2.35
Skelp, sheared steel	2.35
Steel hoops	3.00
Sheets, black, No. 28	3.75
Sheets, galv., No. 28	4.85
Sheets, blue an'l'd, 9&10	3.00
Wire nails	3.00
Plain wire	2.75
Barbed wire, galv.	3.80
Tinplate, 100-lb. box	$5.50

COKE (at ovens).

Welsh foundry 40/– to 45/–
„ furnace 30/– to 35/–
Durham & North. fdy. 45/–
„ furnace 34/9
Other Districts, fndy 45/–
„ furnace 24/–

TINPLATES.

f.o.b. Bristol Channel ports.

I.C. Cokes,	20×14, box	24/3
„	28×20, „	48/6
„	20×10, „	34/3
„	18¾×14, „	24/6
C.W.	20×14, „	22/1½
„	28×20, „	45/3
„	20×10, „	29/9
„	18¾×14, „	22/1½
Terneplates	28×20, „	36/9

SWEDISH IRON.

Bars, hammered £23 to £24
Rolled Ord. £18 to £18 5 0
Nail Rods £18 to £18 5 0
Keg Steel nom. 27 0 0
Faggot Steel nom. 25 0 0
Blooms, Sngle weld. £10 to £12
Do. Single & double £13 to £14
Pig-iron £7/5 to £7 10 0
All f.o.b. Gothenburg.

TUBES.

	Up to and incl. 6 in.	
Gas ..	..52½%	Tube prices are now free.
Water	..47½%	
Steam	..42½%	

DAILY FLUCTUATIONS.

Standard Copper (cash).

	£	s.	d.	
Dec. 20	61	15	0	dec. 5/-
„ 21	61	10	6	„ 5/-
„ 24	—			No market.
„ 25	—			„
„ 26	—			„

Electrolytic Copper.

Dec. 20	67	15	0	No change	
„ 21	67	15	0	„	
„ 24	—			No market.	
„ 25	—			„	
„ 26	—			„	

Standard Tin (cash).

Dec. 20	230	10	0	dec.	45/-
„ 21	235	0	0	inc.	90/-
„ 24	—			No market.	
„ 25	—			„	
„ 26	—			„	

Tin (English ingots).

Dec. 20	231	5	0	dec.	45/-
„ 21	236	0	0	inc.	95/-
„ 24	—			No market.	
„ 25	—			„	
„ 26	—			„	

Zinc Sheets (English).

Dec. 20	38	10	0	No	change
„ 21	38	10	0	„	
„ 24	—			No market.	
„ 25	—			„	
„ 26	—			„	

Spelter (ordinary).

Dec. 20	32	13	9	dec.	2/6
„ 21	32	12	6	„	1/3
„ 24	—			No market.	
„ 25	—			„	
„ 26	—			„	

Lead (English).

Dec. 20	32	5	0	No	change
„ 21	32	5	0	„	
„ 24	—			No market.	
„ 25	—			„	
„ 26	—			„	

AVERAGE MONTHLY PRICES OF DERBYSHIRE NO. 3 FOUNDRY AT MANCHESTER.

Year.	Jan.	Feb	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Yearly average
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
1895 ..	2 3 0..	2 3 6..	2 2 6..	2 2 6..	2 2 6..	2 4 0..	2 3 6	2 4 0..	2 5 0..	2 5 6..	2 6 6..	2 5 6..	2 3 11½
1896 ..	2 5 6..	2 6 0..	2 6 0..	2 6 0..	2 6 0..	2 5 6..	2 5 0..	2 5 0..	2 5 0..	2 6 0..	2 7 0..	2 8 6..	2 5 11½
1897 ..	2 10 0..	2 11 0..	2 9 0..	2 8 6..	2 8 0..	2 7 0..	2 7 0..	2 7 0..	2 6 0..	2 6 0..	2 6 0..	2 7 6..	2 7 9½
1898 ..	2 7 6..	2 8 0..	2 8 0..	2 8 0..	2 8 6..	2 10 0..	2 10 0..	2 10 0..	2 10 0..	2 11 0..	2 14 0..	2 14 0..	2 9 11
1899 ..	2 13 0..	2 14 0..	2 14 0..	2 14 0..	3 0 0..	3 2 0..	3 13 0..	3 16 6..	3 15 0..	3 16 6..	3 16 6..	4 0 0..	3 6 2½
1900 ..	4 0 0..	4 0 0..	4 0 0..	4 1 6..	4 1 0..	3 18 0..	3 13 6..	3 12 6..	3 11 0..	3 11 0..	3 9 6..	3 8 0..	3 15 5
1901 ..	2 13 6..	2 17 0..	2 15 0..	2 15 0..	2 14 0..	2 13 9..	2 13 6..	2 14 6..	2 13 0..	2 12 6..	2 12 6..	2 16 6..	2 14 3½
1902 ..	2 17 6..	2 17 6..	2 15 6..	2 16 9..	2 16 6..	2 16 6..	2 16 6..	2 17 0..	2 18 6..	2 18 6..	2 17 6..	2 17 6..	2 17 1½
1903 ..	2 17 6..	2 17 6..	2 17 6..	2 17 6..	2 17 6..	2 17 6..	2 17 6..	2 17 6..	2 17 6..	2 17 6..	2 17 6..	2 17 6..	2 17 6
1904 ..	2 17 6..	2 17 6..	2 17 6..	2 17 6..	2 17 6..	2 17 6..	2 17 6..	2 17 6..	2 17 6..	2 17 6..	2 17 6..	2 17 6..	2 17 6
1905 ..	2 13 0..	2 13 0..	2 11 6..	2 12 6..	2 12 0..	2 12 0..	2 12 3..	2 12 3..	2 14 0..	2 16 6..	3 0 0..	3 0 6..	2 14 1
1906 ..	3 2 0..	3 5 0..	3 3 0..	3 0 6..	2 17 0..	2 18 6..	2 18 0..	2 16 6..	2 19 0..	3 0 6..	3 1 6..	3 7 0..	3 0 8½
1907 ..	3 7 0..	3 7 0..	3 5 0..	3 2 0..	3 4 0..	3 8 0..	3 6 0..	3 5 0..	3 4 0..	3 2 6..	3 1 0..	2 18 6..	3 4 2
1908 ..	2 15 0..	2 14 6..	2 14 6..	2 15 6..	2 14 0..	2 13 0..	2 13 0..	2 11 6..	2 12 6..	2 13 0..	2 12 6..	2 12 6..	2 13 5½
1909 ..	2 13 0..	2 12 6..	2 11 6..	2 12 0..	2 12 6..	2 12 6..	2 12 0..	2 12 6..	2 14 6..	2 15 0..	2 14 6..	2 14 0..	2 13 0½
1910 ..	2 13 9..	2 14 0..	2 14 0..	2 14 4..	2 15 0..	2 15 0..	2 14 9..	2 15 0..	2 15 0..	2 15 0..	2 15 0..	2 15 0..	2 14 7½
1911 ..	2 16 0..	2 16 0..	2 16 0..	2 16 0..	2 16 0..	2 16 0..	2 16 0..	2 16 0..	2 16 0..	2 14 6..	2 15 0..	2 15 0..	2 15 8½
1912 ..	2 17 4½	2 17 6..	2 17 6..	3 1 1½	3 2 6..	3 3 9..	3 6 3	3 7 6..	3 10 10½	3 12 6..	3 13 3½	3 14 6..	3 5 4
1913 ..	3 15 7..	3 15 0..	3 11 10½	3 11 4½	3 10 2½	3 6 10½	3 4 2½	3 2 9..	3 1 9..	3 1 0..	2 19 3..	2 17 2½	3 6 5
1914 ..	2 17 2½	2 18 0..	2 18 0..	2 17 0..	2 17 0..	2 16 7½	2 16 0..	3 2 10..	3 1 0..	2 19 9½	2 16 11½	2 18 1½	2 18 2½
1915 ..	3 1 2..	3 3 11..	3 5 9..	3 18 8½	3 13 7..	3 14 1..	3 15 0..	3 13 3..	3 12 0½	3 11 1..	3 14 0..	4 3 3..	3 12 2½
1916 ..	4 4 6½	4 11 6..	4 11 6½	4 7 6..	4 7 6..	4 7 6..	4 10 0..	4 12 10..	4 12 6..	4 12 6..	4 12 6..	4 12 6..	4 8 6½
1917 ..	4 12 6..	4 12 6..	4 12 6..	4 12 6..	4 12 6..	4 12 6..	4 12 6..	4 12 6..	4 12 6..	4 12 6..	4 12 6..	4 12 6..	4 12 6
1918 ..	4 12 6..	4 12 6..	4 12 6..	4 12 6..	4 12 6..	4 12 6..	4 12 6..	4 12 6..	4 12 6..	4 12 6..	4 12 6..	4 12 6..	4 12 6
1919 ..	4 12 6..	4 12 6..	4 12 6..	4 12 6..	7 2 6..	7 5 0..	8 8 5..	9 0 0..	9 0 0..	9 0 0..	9 0 0..	9 0 0..	7 3 6
1920 ..	9 13 9..	10 0 0..	10 5 3..	10 15 3..	11 10 0..	12 2 6..	12 5 0..	13 1 3..	14 7 6..	14 5 0..	14 5 0..	14 5 0..	12 12 1½
1921 ..	12 11 8..	10 8 9..	9 2 6..	8 2 0..	8 0 0..	8 0 0..	8 0 0..	8 1 8..	7 4 0..	6 7 6..	5 7 6..	4 16 10..	8 0 2
1922 ..	5 5 0..	4 17 6..	4 15 0..	4 15 0..	4 12 6..	4 12 6..	4 12 6..	4 12 6..	4 11 3..	4 10 0..	4 10 0..	4 10 0..	4 13 7½
1923 ..	4 12 8½	5 0 2..	6 2 6..	6 8 7½	6 2 5..	5 11 7½	5 0 0..	4 16 0..	4 11 10½	4 11 3..	4 12 6..	5 2 9..	5 4 4½

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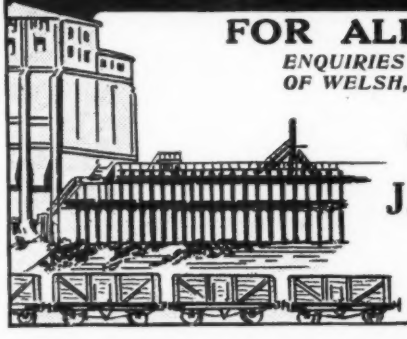

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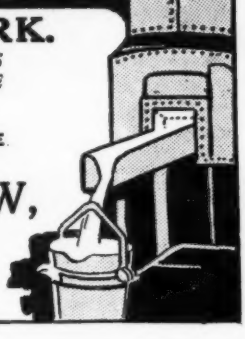

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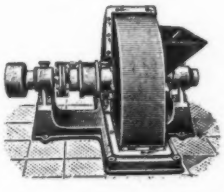

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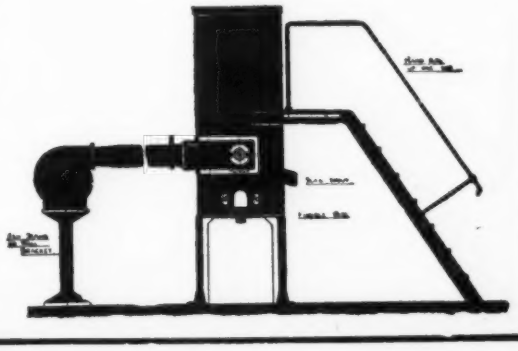

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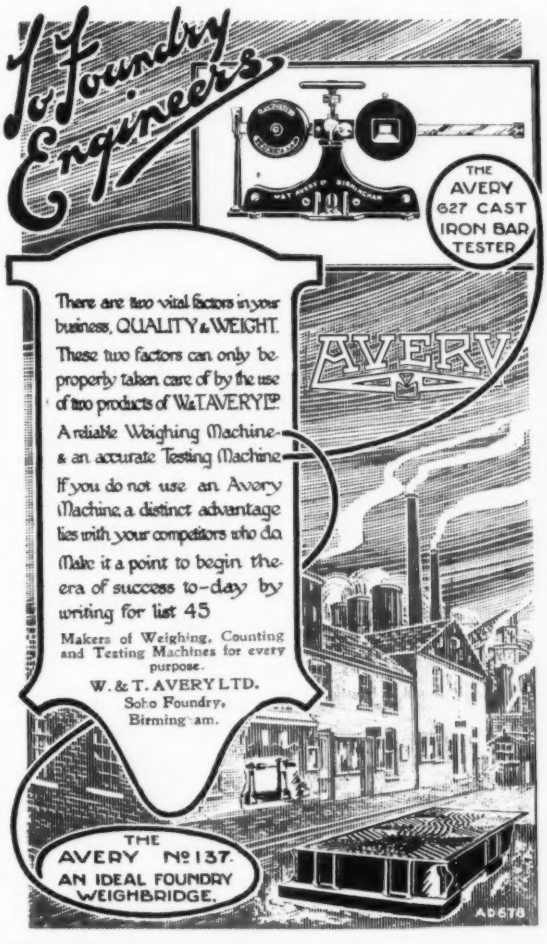
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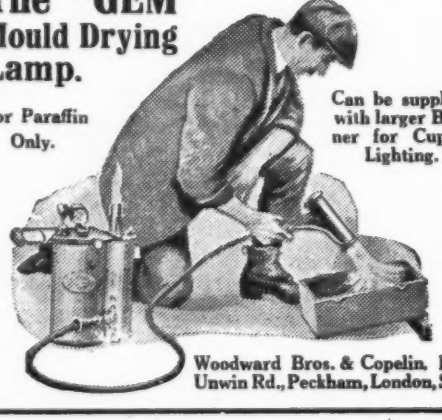
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